

BY A HUNDRED

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AND

Popular Science

FOUNDED MONTHLY 1872



Midocean Landing Fields
for Atlantic Fliers ~page 12

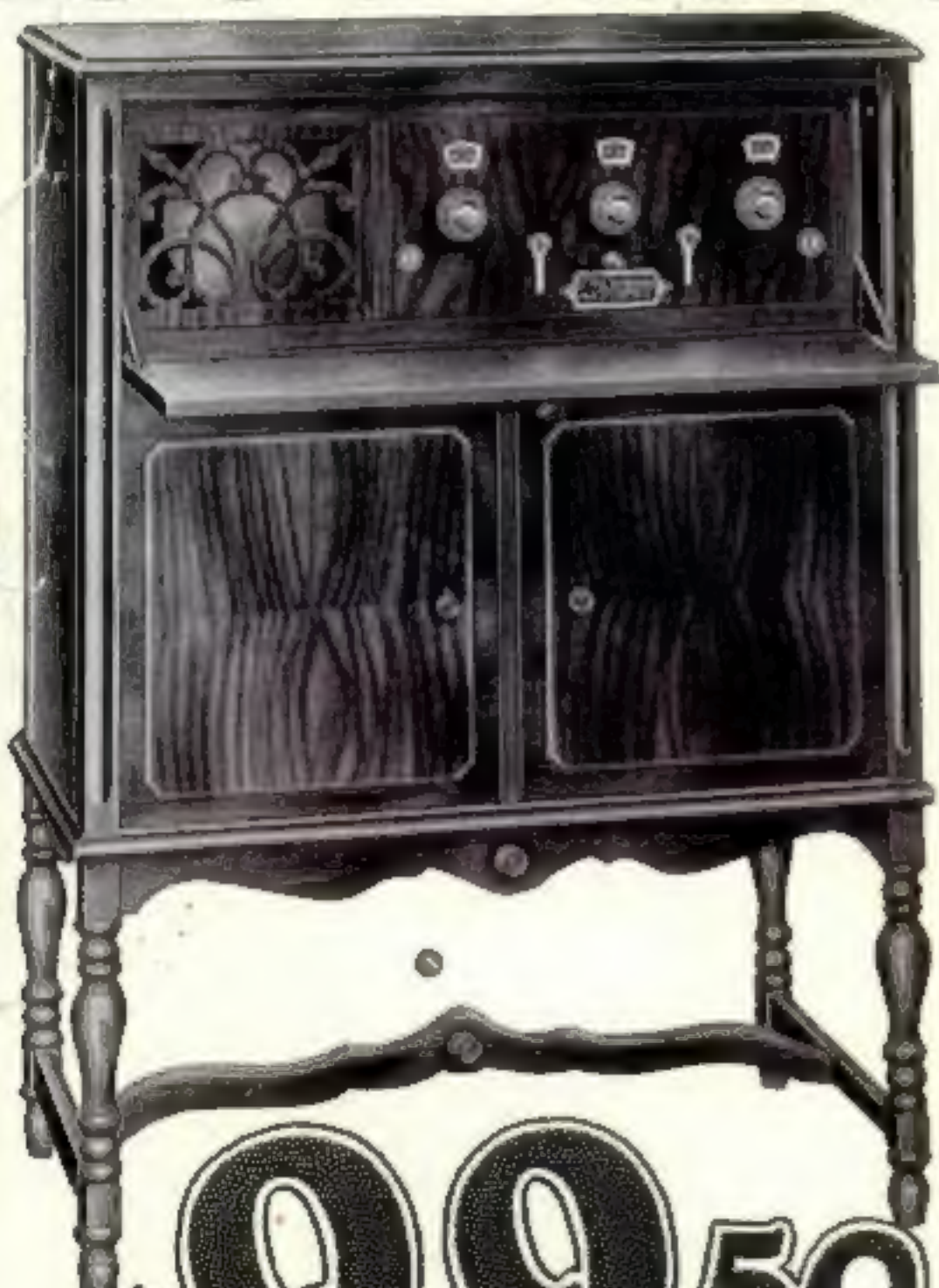
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are shipped with Freshman Masterpiece Receivers — matched and tested for each individual set. Priced with this equipment (one UX 112 Power Tube; one UX 100A Detector Tube; three UX 201A Amplifying Tubes) **\$117**

New and Improved
**FRESHMAN
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A one-piece Console
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One of the finest pieces of furniture in which a radio receiving set has ever been installed. It is truly an aristocrat with its distinctive, finely proportioned lines and rich lustrous finish.

**Equipped with
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**CHAS. FRESHMAN CO., INC.,
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Write for our beautiful new booklet illustrating and describing our 1927 Receivers and Accessories

The World's Great Radio!



A telephone cord—cut away to illustrate its complex make-up. Silks—strong fibred cotton—waterproofing compounds—cover the vital inner parts, tiny twisted threads fine as human hairs.

Like Tony Weller's Coats protection for telephone cords

LOOK at the cord which leads from your telephone. You'd never suspect that it has seven separate protective coverings.

For all the world like Dickens' famous coachman who, we are told, "wore as many clothes as possible"—protection against rough weather.

So this telephone cord is moisture-proof and hard-knock-proof. That fact isn't so important as is the fact that just such care as this is applied in making every Western Electric product—whether it be a small telephone cord or a year's output of 35 billion feet of insulated wires in cable.



Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM



WHAT WOULD FARADAY SAY?

AN EDITORIAL

ELECTRICITY is man's most valuable servant. It has given each of us 250 mechanical slaves, according to Walter Dill Scott, President of Northwestern University. And at the present rate of discovery and invention we each will have available in 1931 the power of 500 men.

Yet it is only about one hundred years since Michael Faraday began to experiment in his London cellar with a magnet and a bit of wire. Less than one hundred years separate us from that first machine embodying the principle of the dynamo, without which we would not have today's electrical wonders; wonders that have provided us, born with only two hands to do our work, with hundreds of hands and strength beyond reckoning.

WHAT would Faraday, who carried his machine about in his pocket, say if he could see our most powerful machine, the mighty generator described on Page 30 of this issue? The power of 94,000 horses ready to race over transmission lines to lighten the labor and enrich the lives of American men and women! Enough energy to light 300,000 six-room houses, operate thirty-one Panama Canals, or forty-seven transcontinental trains!

What would Faraday say if he could see one of our great plants where electrical devices are manufactured—products that, according to Herbert Hoover, do more for you and me every day than all the banks in the world do for us in a year? Faraday, whose annual income never exceeded \$500, contemplating an industry, based on his experiments, that pays billions of dollars

in wages each year to hundreds of thousands of workers!

WHAT would Faraday say if he could see your home and mine? He never even dreamed of our electric refrigerators, our electrically operated oil burners, our telephones, lights, radios, vacuum cleaners, washing machines, dishwashers and the 22,000 other electrical conveniences available to us—machines that do a human being's work for three cents a day.

But, great as Faraday's amazement would be, yours and mine would be even greater if we could see the electrical progress to be made in the next hundred years. After all, we are only just beginning in electricity. We are only on the threshold of a marvelous new age, an age of possibilities so tremendous that we can understand less of them than the kitten asleep in my cellar can of the mechanism of the oil burner.

MEN already are planning to produce hydroelectric power in units of horsepower that run into figures having so many ciphers that the eye cannot follow them on a printed page. Before long electricity, through artificial sunlight, will enable you to have a little vegetable garden or flower garden in your cellar; to see as well as hear over your telephone; and to do a multitude of things undreamed-of today.

Progress in electricity will be limited in the next hundred years only by the limits of human imagination and the limits of human need for energy. We won't really be in the electrical age until man's hardest physical work is pushing a button.—S.N.B.



The New Balkite Charger

MODEL J. Has two charging rates. A low trickle charge rate and a high rate for rapid charging. Can thus be used either as a trickle or as a high rate charger. Noiseless. Large water capacity. Rated with 6-volt battery, 1.5 and .5 amperes; with 4-volt battery, .6 and .2 amperes. Special model for 25-40 cycles. Price \$19.50. West of Rockies \$20.



Balkite Trickle Charger

MODEL K. With 6-volt "A" batteries can be left on continuous or trickle charge thus automatically keeping the battery at full power. With 4-volt batteries can be used as an intermittent charger. Or as a trickle charger if a resistance is added. Charging rate about .5 amperes. Over 200,000 in use. Price \$10. West of Rockies \$10.50.



A New Balkite "B" at \$27.50

Balkite "B" eliminates "B" batteries and supplies "B" current from the light socket. Noiseless. Permanent. Employs no tubes and requires no replacements. Three new models. Balkite "B"-W at \$27.50 for sets of 5 tubes or less requiring 67 to 90 volts. Balkite "B"-X for sets of 8 tubes or less; capacity 30 milliamperes at 135 volts—\$42. Balkite "B"-Y, for any radio set; capacity 40 milliamperes at 150 volts—\$69.



Balkite Combination

When connected to your "A" battery supplies automatic power to both "A" and "B" circuits. Controlled by the filament switch on your set. Entirely automatic in operation. Can be put either near the set or in a remote location. Will serve any set now using either 4 or 6-volt "A" batteries and requiring not more than 30 milliamperes at 135 volts of "B" current—practically all sets of up to 8 tubes. Price \$59.50. All Balkite Radio Power Units operate from 110-120 volt AC current with models for both 60 and 50 cycles. Prices are higher in Canada.

Operate your radio set from the light socket

Either with a Balkite Charger and Balkite "B" or with the new Balkite Combination Radio Power Unit.

The most convenient way of operating your radio set is from the light socket. Now you can do it merely by adding either the new Balkite Combination or Balkite "B" and a Balkite Charger. Either way will give you full silent power for both circuits from the light socket.

All Balkite Radio Power Units are permanent pieces of equipment. They use no tubes. They have nothing to wear out or require replacement. They are noiseless. They do not hum. They always give just the power needed by the set because they do not run down or run low. Other than a slight consumption of household current their first cost is the last. With sets of high current requirements they effect a decided saving.

Operate your set with Balkite Light Socket Power. Over 600,000 receivers—one of every ten—are already Balkite equipped. Equip yours with Balkite and convert it into a light socket set. Know the pleasure and satisfaction of owning a set always ready to operate at its best.

FANSTEEL
Balkite
Radio Power Units

Manufactured by FANSTEEL PRODUCTS COMPANY, INC., North Chicago, Illinois



[[The purpose of this new Department is to help Readers of POPULAR SCIENCE MONTHLY save money and invest it safely and profitably]]

How \$100 a Month, Properly Invested, Makes You Independent

By WALLACE AMES, Financial Editor

"DO YOU mean to tell me," said John Blake, somewhat skeptically, "that if I had begun investing \$100 a month regularly fifteen years ago, I could for the next fifteen years draw out \$45 each month and then have \$58,090 left?"

"Why, if I had invested \$100 a month, or only \$1,200 a year, for the past fifteen years, that would be a total of only \$18,000. Then \$45 a month drawn out for the next fifteen years would be \$8,100 taken back. That would leave only \$9,900 of my earnings left in the investment. And you mean to tell me that in place of this \$9,900 I could have \$58,090! Seems incredible," concluded John.

"I mean to tell you," explained his friend, Ed Larkin, "that such a result is mathematically possible. \$100 monthly for fifteen years, at 6% interest compounded semi-annually, amounts to \$29,045. That sum at 6% pays \$1,742.70 annually or \$145.23 monthly. This provides \$100 a month to continue investing for a second period of fifteen years, and \$45 a month extra which could be drawn out and spent.

"You can invest in good bonds that pay 6% or more. Most investment bankers will sell you bonds on monthly payments and allow interest on those payments. Then if, as soon as interest comes due on your bonds, you apply it toward the purchase of more bonds, your interest is immediately earning more interest. Thus you are getting the practical equivalent of compound interest.

"Of course, if you slip up now and then the final result would be affected. But this example nevertheless shows the surprising possibilities of systematic investment."

THESE quite amazing figures were brought to light during a serious little visit which two old friends were having one evening, when one sought to learn the other's secret of financial success.

John Blake and Ed Larkin had started their business careers at the same time and with similar opportunities. Both had earned good incomes, but after eighteen years John

had nothing laid by while Ed was well fixed. John had asked Ed to dine with him so he could put some pointed questions to his well-to-do friend about the important business of get-

A New Service

for Readers of

POPULAR SCIENCE MONTHLY

THIS new Department is to help readers in the establishment of proper financial programs at the beginning of their business careers; it assists those who have accumulated money in the proper investment of it so that it will be safe and so that it will grow.

The Editor of this Department is an authority on investment matters and he will not only every month give the readers interesting and useful information in his articles, but is also ready to aid in personal investment problems. Advice will be gladly given regarding the proper investment of funds and proper plans of saving.

Address all your inquiries to Wallace Ames, Financial Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

Any advertising appearing in this section will be carefully investigated by the Publisher of POPULAR SCIENCE MONTHLY. Readers can be sure that companies advertising are reliable and that they offer securities which represent sound financial investments. While investments obviously cannot be guaranteed by the Publisher, every effort will be made to insure that only advertisements of absolutely reliable companies are accepted.

ting ahead. After dinner they found a quiet corner and John opened up.

"Ed, when you and I were just starting out you will remember that it was my ambition to be earning \$10,000 a year by the time I was thirty-five years old. Well, it so happened that I hit the \$10,000-mark a few months before my thirty-fifth birthday. But it didn't mean anything as I had nothing to show for it. When I learned how well off you are and recalled how we started with equal opportunities, I

realized that there was something radically wrong with my system. So I am asking you, as an old friend, to diagnose my trouble and prescribe a remedy."

"Well, John," started his friend, "your request may lead to some pretty personal comments, but I can stand it if you can. I know your trouble and I will be very glad to suggest how you may correct it."

"Shoot," said John, "I am at your mercy. I know your criticisms will be justified, and your suggestions will be sweet music to my ears."

"To begin with, John, you started your business life with the wrong point of view about earnings, as you yourself have suggested. Your aim was to earn a lot of money. But what for? Partly so you could have everything you wanted, and you wanted a lot. Partly so you could pile up a snug fortune. But there were always so many things you wanted to get with your money and saving a small sum regularly always seemed to you too slow a method of getting ahead. So you indulged in things you could just as well have done without and when there was a little money left you always lost it taking fliers.

"WE ALL want to pile up money rapidly. But too many of us, in trying to make our money grow fast, choose methods which end up with serious losses. That's been part of your trouble—to make up for free spending you have made hazardous investments, hoping for big gains, not realizing what substantial gains you could make safely."

Then Ed showed John a booklet of figures and tables which offered the surprising results mentioned at the beginning of this article.

"I could easily have saved \$100 a month for the past fifteen years," mused John, "but I didn't do it because, as you say, I thought it was too slow. I guess I forgot the compound interest lessons I learned in school."

"WHILE we are on the subject," continued Ed, "I have some other figures here which show you what a great little worker interest is. This table shows what happens to a steady investment (Continued on page 5)

How \$100 a Month Can Make You Independent

(Continued from page 4)

of \$50 a month when 6% interest is allowed to do its work steadily."

The slip Ed took out of his pocket had the following figures on it:

\$50 SAVED EACH MONTH

	Without Interest	6% Simple Interest	6% Semi-Annual Compound Interest
5 years	\$3,000	\$3,457.50	\$3,499.50
10 years	6,000	7,815.00	8,202.00
15 years	9,000	13,702.50	14,512.50

6% simple interest shows a gain of \$4,072.50 or 41% gain over the total amount saved in 15 years. 6% compound interest shows an additional gain of \$1,450, a total gain of \$5,512.50, or 61 1/6% gain over the total amount saved.

"Now," resumed Ed, "both of these examples pertain to regular monthly investing of small sums. Let us see what happens when a single large sum is subjected to compound interest treatment. Here are some figures I took from compound interest tables."

\$10,000 AT 6% SEMI-ANNUAL COMPOUND INTEREST

At the end of	\$10,000 has grown to
3 years	\$11,940
6 years	14,137
9 years	17,024
12 years	20,317
15 years	24,272

7% semi-annual compound interest shows a gain of \$18,067 on \$10,000 in fifteen years, or 180% gain on the original amount. The results are proportionately the same on any sum.

Remember that the original investment is not increased except by interest. See how the interest gain increases during each succeeding three-year period, how money increases its ability to grow with practice.

"These are just figures, but they show you what you can do with money if you are willing to save and invest it. You can get compound interest at 3 1/2% or 4% through the savings bank, but there is no way for you to get perfect compound interest at 5%, 6%, 7% or 8% so as to make your money grow to the exact penny the way it figures out in the interest tables. But you can invest in sound bonds paying 5%, 6%, 7% or 8% and by reinvesting your interest coupons as they come due it is a simple matter to get the practical equivalent of perfect compound interest."

"That's it," concluded Ed. "The simple, sure device of compound interest will get for you what you want—substantial, quick gains. And compound interest works well with sound bonds. It isn't necessary to take risks."

"Loan me that booklet, Ed. I want to write that investment company."

Money Making Booklets

Reviewed by the Financial Editor

THE booklets reviewed below will assist any investor to get ahead financially. You may obtain any of them, without charge from the issuing house, by writing The Financial Department of POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. For convenience order by number as given below.

"HOW TO BUILD AN INDEPENDENT INCOME," published by The F. H. Smith Company, presents a modern way of saving money, explains how first mortgage bonds may be purchased by monthly deposits, and presents tables showing results attainable by carrying out their plan for a period of years. Ask for Booklet No. 1.

"DIVERSIFICATION AND VIGILANCE," published by A. B. Leach & Co., presents a brief analysis of seven basic principles that assure success in the management of personal investments. Ask for Booklet No. 2.

"INCREASE YOUR INCOME 15% TO 60%," one of several pamphlets published by The Adair Realty & Trust Co., explains how the investor can get 6 1/4% on money now earning 4% or 5%, and be safeguarded by guaranteed mortgage bonds. Ask for Booklet No. 3.

"FORTY-FOUR YEARS WITHOUT LOSS TO ANY INVESTOR," published by S. W. Straus & Co., presents the safety record of this house and describes the safeguards constituting the Straus Plan. Ask for Booklet No. 4.

"SAFE BONDS FOR INVESTMENT," published by Halcy, Stuart & Co., presents their current list of diversified investment offerings, with instructive investment comment. Ask for Booklet No. 5.

"EYE WITNESS TESTIMONY," published by The

Trust Company of Florida, reprints letters from investors, telling in their own words their experiences with, and their opinion of the service and mortgage bonds offered by that Trust Company. Ask for Booklet No. 6.

"HOW TO GROW AND HARVEST DOLLARS," published by H. O. Stone & Co., describes a savings-investment plan offered by that Company, and describes how to accumulate from \$4,603.25 to \$46,032.47 by monthly investment of from \$10 to \$100. Ask for Booklet No. 7.

"AN INVESTMENT INSURED FOR ITS LIFETIME," published by Mortgage Security Company of America, describes their plan of issuing insured mortgage investments. Nine points of safety are explained. Ask for Booklet No. 8.

"BOND RECORD," published by American Bond & Mortgage Company, is a loose leaf booklet in which the investor may conveniently keep a record of his investments. Ask for Booklet No. 9.

"BUYING BONDS BY MAIL," published by A. C. Allyn and Company, explains how the investor may safely and conveniently deal with an investment banker through the mails, and without the usual advantage of direct contact. This booklet covers points of special interest to investors who cannot readily visit their investment banker personally when they have funds to invest. Ask for Booklet No. 10.

"YOUR MONEY," one of several booklets published by Fidelity Bond and Mortgage Co., covers the points of general interest to the investor who is planning to put his money in sound mortgage bond investments. Ask for Booklet No. 11.



There's an Eversharp for you in any style and size you want. This one sells at \$3

Wahl Pens are made in new shades of marbled, red and black. This one sells at \$7

A great team is the hand and brain, no matter what your goal.

Train them together, in school and in the game of life, for your victory.

Out of the shifting play of the mind, select and perfect that flashing thought which promises Success.

Drill yourself in the practice of fixing it down to fighting trim:

PUT IT ON PAPER!

Success waits on the man who keeps in line with his thinking these best friends of an active brain,

EVERSHARP
and
WAHL PEN

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The Wahl Company, Ltd., Toronto



Taking the GUESSWORK out of **BUYING AN OIL BURNER**

THE selection of an oil burner amounts to guesswork in the majority of cases, and it is a gamble that few can afford. To eliminate this, the Popular Science Institute of Standards has taken some very definite steps to aid purchasers of oil burning equipment.

An oil burner, to give satisfaction, must be efficient, must be safe and must be adapted to the heating system and requirements of the user. These, then, are the points that the Popular Science Institute determines in making recommendations of oil burners. It means a great deal of research, and the personal attention of experts to individual problems, in order to do this.

In determining what oil burners to recommend, an entirely different course has had to be followed by the Popular Science Institute of Standards than in making radio and tool recommendations. In the case of the latter type of equipment, it was possible to make actual laboratory and practical tests that would exactly duplicate use under all and any conditions. From the results of these tests, the Institute could authoritatively advise just what radio and tool products would give satisfaction.

The findings have been just as accurate in the case of oil burners, but the investigation is of a different nature. It is impossible to test an oil burner for efficiency by laboratory methods, since the oil burner does not form an operating unit in itself but becomes part of a heating system—a system which cannot be tested, since

it differs in every instance. The Institute therefore has adopted the only other method of finding which burners were efficient—it has made a survey of thousands of oil burner installations from New York to California and determined just how satisfactory the installation was in every case.

The only burners that the Institute has investigated or will consider recommending are those that have been found free from fire hazard by the Underwriters' Laboratories and listed by them as approved. The Underwriters' Laboratories make very exhaustive tests for this one particular point of safety from fire and their findings are generally accepted as conclusive. No attempt is made by the Underwriters to determine efficiency.

The Popular Science Institute's sur-

vey covers oil burners from the standpoint of efficiency, the tests of the Underwriters' Laboratories for safety, and there then remains the third essential point that the oil burner be adapted to the heating system and house in which it is to be installed. To make certain of this agreement of burner and the rest of the heating plant, the Popular Science Institute of Standards requires certain information from the prospective oil burner purchaser before making any recommendations. From the information submitted, the Institute determines what type of oil burner would prove most suitable. As the efficient operation of an oil burner depends largely on (1) its proper installation and (2) its proper servicing, the Institute only recommends oil burners that can be installed and serviced in the prospective purchaser's locality. To determine this latter point, the Institute consults its record of location of oil burner representatives, and unless a burner can be serviced within a radius of fifteen miles, it is not recommended by the Institute.

THE advice of the Institute is available to every reader of POPULAR SCIENCE MONTHLY who is considering the installation of an oil burner. Readers interested in securing such advice should write for a chart on which to fill in the information that the Institute requires before making any recommendations.

Address letters to Popular Science Institute, 250 Fourth Ave., New York.

Popular Science Monthly **GUARANTEE**

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY.

THE PUBLISHERS



Type R-14—3 to 1 : : : : \$4.50
Type R-13—5 to 1 : : : : 2.00

New!



ALL-AMERICAN TRADE MARK AUDIO TRANSFORMER

This latest development meets the new demands for compact wiring and longer life—

Binding Posts are conveniently located for straight or sub-panel wiring—

The coil is vacuum impregnated—

After assembly the shell is filled with special compound and the complete unit hermetically sealed. *A transformer that sets a new standard.*

Tone Quality Is the Keynote

No standards of quality can be higher than those we set for our own products; no inspection is more rigid; no tests more severe.

Each of these All-American Transformers plays its part in determining the quality

of radio reception. Each is designed and made with the same care that goes into the finest receiving sets.

These products have helped to create All-American leadership.

New 1927 Radio Key Book

Everybody who enjoys radio should read it—an interesting 48-page analysis of radio in terms anybody can understand; with complete constructional details of the leading types of circuits. Send 10c in coin or stamps for your copy.



UNIVERSAL COUPLER highly efficient both as antenna coupler and tuned R.F. Transformer



SELF-TUNED R.F. TRANSFORMER effectively amplifies all frequencies. Designed to match tube characteristics

All-American Radio Corporation
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RAILROAD-TRIO
An inductance, a resistance and a capacity perfectly balanced in one shell—a compact factory-built unit for impedance coupled amplification



POWER (PUSH-PULL) AMPLIFYING TRANSFORMER gives power amplification without distortion where excessive volume is demanded



RAILROAD-LYRIC
An audio Transformer, famous for its perfect tone reproduction—an outstanding product. Made with painstaking thoroughness without regard to cost



Two Great Receivers

that cover the full range of radio broadcasting

from
10 to 200 meters

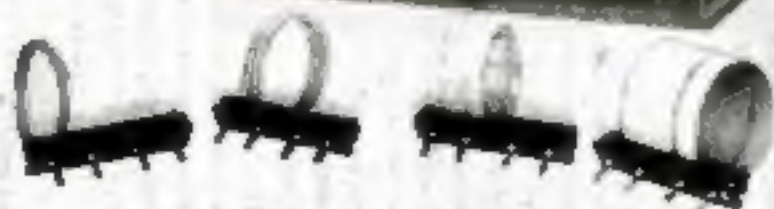
THE Grebe CR-18 is an exceptional receiver for high radio frequency reception. It employs a coupled regenerative circuit adapted for a frequency range of from 1500 to 30,000 kilocycles (10 to 200 meters) and is especially designed to meet all amateur requirements and radio frequency assignments of the U. S. Department of Commerce.

There are seven outstanding features that make the CR-18 especially efficient.

*Write for charts and
folder describing
these features.*

CR-18

Front view of
CR-18 with 200
meter coil in place
and additional
coils for 10, 20,
40 and 80 meter
bands.



All Grebe apparatus is covered by patents granted and pending.

A. H. Grebe & Co., Inc., 109 West 57th St., New York
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from
150 to 550 meters

THE extreme efficiency of the Synchrophase is due to several exclusive Grebe developments, especially the **Binocular Coils** which provide exceptional selective sensitivity; **Colortone** which gives control over tone quality; **S-L-F Condensers** which make accurate tuning easy; and **Low-Wave Extension Circuits** which give a tuning range of from 550 down to 150 meters, covering over 100 stations not reached by other sets.

*Write for Booklet P.
Then ask your dealer
to demonstrate.*

SYNCHROPHASE

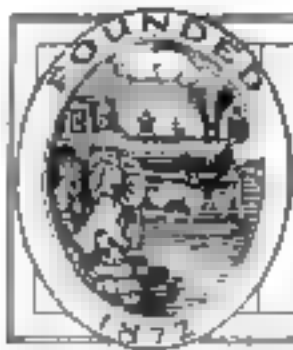


Also supplied with
battery base



Enter 114

This Company owns
and operates stations
WAHG and WBOQ



A Famous Coach Discloses Some

FOOTBALL SECRETS

How a light team, taught to think and act in unison, can outplay heavier opponents through the rhythm of its movements—Some effective plays explained

By Jess B. Hawley

RHYTHM, more than anything else, is the factor responsible for such success as I have had as a football coach. Its proper application in team play is the foundation of all successful football. The coach who succeeds in instilling a sense of rhythm into his squad has more than half won his coaching battle.

Practically every successful physical effort is rhythmic, from the swing of the blacksmith's sledge to the movements of variety dancers. There can be no grace of motion without rhythm, and there can be no muscular coordination without graceful motion. It doesn't matter what sort of athlete you visualize, whether the aesthetic dancer, the boxer, the golfer, the swimmer, the baseball pitcher, the pole vaulter, the tennis player, the skater, or the fleet halfback on a football team; rhythm of motion is inseparable from their achievements. The slow motion camera discloses the rhythm beyond question.

Timed unison in thinking and acting gives eleven eager men on a football team an almost irresistible advantage over another eleven that has not learned to coordinate the actions of individuals into team rhythm. It is one of the most essential qualities of a successful football team, both as an offensive and as a defensive measure. I have proved this, time and again, during my years of coaching at Iowa and at Dartmouth.

It is an engineering fact—and an obvious one—that eleven light men, timing their motions with an exactness that enables the eleven to hit the opposing line as one man, can smash through much heavier opponents with an

ease that would be utterly impossible if the shock of attack were untimed, unsynchronized, without rhythm.

Of course the heavier the rhythmical team the greater the shock of attack. The speed of the rhythm is an important secret of success. It is easy to demonstrate that an object weighing 200 pounds can be much further deflected by a man weighing 150 after a run of fifty yards in six seconds than by a man who weighs 200 pounds, but who takes twelve seconds to reach the same object from the same starting point.

You can prove that for yourself rather easily by raising your foot to a certain height and letting it drop to the floor in definite rhythm, then put the line of the rhythm in half and see how much more power there is in the stroke. There has been no change in weight, no change in distance from the floor; only a change in time of rhythm.

Possibly the best example of the value

of rhythm in football I can cite is a play made by Dartmouth in the Chicago game last year. Dartmouth kicked off to Chicago. Our ends, of course, went down with the ball. A Chicago player tried for it, but missed. The ball struck his headgear and bounded toward Sage of Dartmouth. Now remember, every Dartmouth player was acting in timed unison rhythm.

SAGE saw the break, knew that if he broke rhythm and tried for it, he probably would recover the ball for Dartmouth, but he knew also that the Dartmouth line was three and four strides behind him, and that Captain Parker was in unison of movement with him. He would throw Parker's playing off if he broke unison. By count, Sage continued his play, which was to get his man out of the way for Parker, so the latter could get the ball and get away with it.

Sage did just that. Rather than break the perfect team rhythm, Sage passed up an opportunity to grandstand. He undoubtedly could have recovered the ball, and just possibly might not have been downed in his tracks. But he knew, without once turning his head to see, that Parker was in rhythm and that Parker would be on the ball at the exact instant Sage was blocking the Chicago player, while the Dartmouth line was getting into action.

The result was that Parker ran thirty yards for a touchdown.

But, before going more definitely into an analysis of rhythm, I think it proper in any discussion concerning the creation of an outstanding college football eleven

Can Dartmouth Repeat?

NO FOOTBALL coach in the country is being more closely watched this fall than Jess Hawley of Dartmouth College. With a system of training peculiarly his own, he has developed championship elevens at the University of Iowa and at Dartmouth. Last year, the Dartmouth team smashed time and again through heavier opposing lines, winning every game played.

On these pages Mr. Hawley reveals how he has applied science to football to obtain such results, and explains the prearranged speed and stride from which his players never deviate. Never has there been published anywhere such a comprehensive, understandable article on the building of a successful football machine.

to begin with fundamental necessities.

From that standpoint, I should say that the most vital factor in college football is the psychology of tradition. Therefore, the first duty of a football coach is to steep himself and his staff in the tradition of the school—the honor for which his eleven will fight in play.

It also is tremendously important to fan undergraduate and alumni support and enthusiasm into active, hot flame. For this support and enthusiasm drives a sense of responsibility into the men on the squad. The story of school tradition becomes a thing to be cherished, sacrosanct; and there is born the vigorous determination to live up to its lofty standards.

A FEW years ago, in 1910 to be exact, we had an outstanding illustration of the loyalty that turns defeat into victory. Dartmouth was playing one of the strongest teams in the East. The game opened with a touchdown against Dartmouth from the kick-off. A fast man got the ball and our eleven wasn't fast enough to get him. To make matters worse, three minutes later a Dartmouth man fumbled, and our opponents made another touchdown.

Dartmouth was not good enough to beat that team, but Captain Jack Cannell—now my first assistant—called his team together and hammered tradition into it; called on those boys to demonstrate their right to wear the green jersey, an emblem for so many generations. The result was that that team went back into play with a dash and vigor that I had never seen it display—and won the game.

Given a background of tradition, the successful football coach then must turn to the systematic planning of team structure, as well as team development. The basis of team structure may be summarized by the phrases "thorough understanding of the game," and "intelligent playing." Each player should be analyzed for the following inherent qualities, listed in order of their importance:

1. Courage
2. Physical skill
3. Mental capacity
 - (a) Ability to understand theory of play and its details
 - (b) Fast decisions, initiative
 - (c) Coordination of brain and brawn

WE, AT Dartmouth, call our department of psychology to our aid. No two of the men on a football squad are alike. The knowledge given the coach by his staff of psychologists enables him to bring about the proper reaction from each of his men when the occasion for it demands.

The psychologist also aids the coach in summing up a candidate's native ability to coordinate brain and muscle. Definite tests have been evolved at Dartmouth. I could not, in loyalty, disclose all of these, but I can safely cite one of the simpler and yet important ones.

The candidate is placed before the coach, face to face, with the psychologist acting as a sort of referee.

"Follow my words, not my movements," explains the coach. "Hands on hips; hands on shoulders; hands on head."

These orders, with the coach and candidate going through the corresponding motions, are repeated variously and with increasing rapidity several times, and then comes the order.

"Hands on hips; hands on shoulders,



Jess Hawley

Football followers everywhere are expecting the red-headed Chicago business man who coaches Dartmouth to produce once again a championship eleven for his Alma Mater

hands on head." But the coach places hands on hips or shoulders instead of head. That simple test in brain and muscle coordination—quick thinking and quick telegraphy of thought to muscles—has sounded the death knell of hope for many otherwise well-fitted candidates.

The importance of such coordination has been displayed strikingly by Princeton

on several occasions. It is traditional of Princeton coaching that much emphasis is placed on the fact that in every football game there is a loose ball, and Princeton players must take advantage of every loose ball. Sam White displayed its value very nicely in 1919 when, in games with Harvard and Yale, he grabbed the loose balls for winning touchdowns, and repeated against Harvard in 1920.

Courage, the great self-effacing heart of a man, that is vital. Without courage, intellectual capacity, brawn, skill—all sink into nothingness.

Two years ago Larry Leavitt, Dartmouth fullback, gave a striking illustration of what sheer courage will do.

We had gone up against a team that displayed unexpected ability. Leavitt was not in the best physical shape, and we were holding him back for what we considered a more important game. Toward the end of the last half, however, the score was a nothing-to-nothing tie, and the ball was in our possession in the middle of the field.

L EAVITT begged to be sent in. He was. With him, the team found one weak spot in the opponents' line—just one. Again and again Leavitt plunged through that spot. Hurt, tired and battered, he wouldn't quit. Every time he hit he gained from three to four yards, never more; never less. With tears in his eyes, but with joy and tremendous courage in his heart, he fought on until he had smashed his way across the goal line—winning the game for Dartmouth.

With a team structure composed of men who possess the fundamental qualities that I have outlined, the coach is in position to develop a championship team. The remainder is up to him. Taking his men as individuals into consideration, cataloguing the maximum abilities of each, the coach then must plan the football possibilities for them.

Perhaps he finds that the team he has selected from the material that is available is lighter in weight than any other team represented on the forthcoming schedule. If so, his plan of play must be formulated in accordance with the utmost that can be derived from his squad—maximum possibilities again. It is under such circumstances that the element of timing of play, or rhythm, enters largely into the calculation.

O F COURSE, the greatest possible speed of rhythm should be developed, and the lighter the team, the greater the team speed must be, and the more accurate. Very seldom do you see a heavy team display as much speed as a lighter one is capable of showing, and that is what gives the lighter team a more even chance when heavily outweighed—speed of rhythm.

That can be understood by recalling the reported effect of the Charleston on dance floors, compared with the fox trot, or one-step. Both the fox trot and the one-step are rhythmic. They can't be anything else; but the rhythmic beat in those dances is different, slower, than the succession of beats in the Charleston. It is the difference in the beat timing that puts a dangerous strain on dance floors when a group engages in the Charleston.

Proper timing, or rhythm, also enables

every man on the team to jump into synchronized action at the exact instant in which the ball is being put into play. And that is a tremendous advantage. It is the futile effort to do that very thing by players who are not taught properly that results in off-side playing, and consequent penalties. Coordination of rhythmic thought and action prevents off-side play. Mere rhythm of motion will not do it. Exact timing of thought with action is absolutely necessary.

The way in which that coordination is brought about, if the player is capable of accomplishing such coordination, is through speed—speed of every action in practice or in play. When I put my men through practice I invariably demand, and force, speed, top speed, for it is only when maximum individual speed is being employed that the proper timing of team play can be brought about.

OF COURSE it is not possible for each player to have the same speed capacity—some are slower, some are faster. The coach then must make his plan of play in accordance with individual speed as well as group speed. The slower boys are put where they have less ground to cover in order to arrive at their objective, but they are put where their top speed must be exerted.

In the diamond formation, for instance, the man who is at the line tangent of that formation is slower than the men who are back of him. But because all of them have practiced and learned that play at top speed, and timed speed, they deliver their full force in exact unison.

Another phase of playing that is dominated by rhythmic coordination of mind and muscle is the catching of punts. A fumbled punt almost always is the result of self-consciousness on the part of the player. In his effort to catch the

TIMED UNISON

Notice that Lane, of the 1915 Dartmouth team, shows streaking through Harvard's line, and his interferers are all in perfect step. The play was successful because each man kept to his prearranged stride.



ball he suddenly becomes conscious of his opponents thundering down upon him, or some other factor may enter into the play that makes him mentally conscious of his effort and so disturb the balance of rhythmic coordination.

FREQUENTLY coaches themselves are responsible for the creation of that imbalance, and many an excellent back has been ruined through coaching tactics alone. Suppose, as an example, a back drops a punt or two in practice under conditions in which he really should have caught the ball. The coach is so likely to berate him, maybe chase him from the field for the day. In most cases the psychological reaction is disastrous, for the next time that back is called upon to catch punts he is so self-conscious, so over-eager, that he will fumble the ball in most cases.

I would handle that back in a different way. He needs no scolding. His mind and heart, both, were in the catching of the ball. He needed more train-

ing in mass rhythm, so that, without conscious effort of mind, his muscles would re-

spond unerringly and mechanically to the situation that his brain had encompassed.

To give another example of mass efficiency due to rhythm, I might point to the military drill. The best-drilled company is the one whose drillmaster has an exact sense of rhythm, and who can give his commands in accordance with that sense. The best track men are those whose sense of rhythm tells them the fraction of the second at which the starting gun will speak. Some of them have the sense of rhythm so coordinated with physical rhythm that they can "jump the gun" by a split second, and so obtain a great advantage in the sprints.

IT IS impossible for me to go deeper into this matter of rhythm, but you all remember the Four Horsemen who won fame for themselves on the Notre Dame eleven of 1924. It was their application of rhythm and speed, consciously or not, that made them so formidable despite their light weight.

I train my men to measure their opponents' strength at the beginning of play. They swing into this guard or that guard; play this tackle or that tackle; plunge center, or run ends.

And when they have found the most vulnerable spot, they hammer, hammer, hammer with timed power at that man, breaking his physical strength, disturbing his mental poise, and, sometimes, routing his courage.

There is one more problem that confronts a coach. That is physical training. Every man has his physical capacity, and that must be jealously and anxiously guarded. The player who is kept going up to his maximum physical ability soon begins to break under the physical strain, but the player who is kept going close to the limit of his physical capacity keeps perfectly fit. There must be a balance. When players are driven beyond their individual physical capacities, team play goes to smash.

COORDINATION

Swede Oberlander, famous Dartmouth halfback, an excellent example of what Mr. Hawley calls mental and physical coordination, scoring Harvard's line for a touchdown in last year's game.



Will We HOP *the*

American Engineer Plans to Span the Atlantic with Mid-Ocean Landing Fields, Enabling Airplanes to Make the Flight in 34 Hours

A BROAD-SHOULDERED, deep-chested, active man, whose sun-burned face, contrasted markedly with his blond hair, and whose costume of white trousers, sport shirt and rubber-soled shoes suggested a tournament tennis player, stepped briskly to the edge of the swimming pool on his picturesque estate at Holly Oak, Delaware, a few weeks ago.

In his arms was an odd contrivance—a flat metal sheet, six feet by two feet approximately, supported by fifty-two spinily rods that resembled arrow shafts and were trussed and braced like a miniature bridge. About a foot from the top, each rod was thrust through a double-pointed cylinder of translucent material. Six inches or so below the cylinders, the sixteen rods at each end carried each a disk of the same translucent material, four or five inches in diameter.

Carefully, gingerly, the man leaned over the wall of the pool and placed his frail-looking burden in the water. It sank slowly to about three quarters the length of the rods, and finally came to rest with the cylinders almost completely submerged and its metal platform a foot above the still surface of the water.

The white-clad man quickly fastened a line from one end of the floating platform to a small red buoy. Then he placed beside the platform a five-foot scale model of the ocean steamship *Majestic*. Floating there, the two objects suggested a great trans-Atlantic liner about to be moored to its pier.



Edw. R. Armstrong with his model "floating dock" with which he demonstrated recently, to a notable gathering of engineers, his plan for mid-ocean airplane landing stations. The model of the *Majestic* was used for contrast.

The high spot of the remarkable demonstration occurred when Mr. Armstrong operated a wave-making machine, shown above, duplicating, relatively heavy sea conditions which rocked the model *Majestic* like a cork but didn't budge the floating dock. Eight such conditions, Mr. Armstrong hopes, will bridge the Atlantic providing landings for planes.

The man strode to a corner of the pool and seized a vertical metal lever, which he began to move back and forward with sweeps of his muscular arm. As the lever moved, a plank, hinged lengthwise below the water level across the corner of the pool, rocked up and down, churning up waves which swept across the pool toward the platform and the model liner. In a few seconds the mirrorlike pool was transformed into a miniature North Atlantic in winter. The howl of the gales was the only element lacking to make this demonstration a perfect small-scale replica of the fiercest ocean storm.

IN A group of men clustered on one side of the pool while this was going on were distinguished engineers, naval architects, aviation experts and officers of the Army and Navy air services. Members of this group began to nudge one another, to point, to talk in excited whispers. For they were witnessing a spectacle that was not only unique in their experience but apparently contrary to all known principles of physics.

Here were two bodies floating in water that was being agitated into waves which in proportion to the size of the bodies obviously exceeded in amplitude and intensity the mightiest rollers with which ocean steamships have to cope; and yet,

while one object pitched, tossed and otherwise behaved as a buoyant body should in turbulent water, the other remained still and level as the proverbial billiard table!

For the queer structure which was the first placed in the pool had not moved. Around it and beneath its platform the water rose and fell, waves reflected back from the sides of the pool collided with new waves created as the demonstrator moved his lever, causing sudden upheavals, quick gusts and whirling eddies. The tiny liner was swamped in no time, but the pierlike platform stood stable and still as though its supports were solidly embedded in the floor of the pool.

THIS was consummated a demonstration which, in the opinion of some of those who observed it, may eventually usher in a new era in transportation and so take rank with the epochal events of the world's history.

The odd platform which seemed impervious to the action of the waves is the perfected model of a mid-ocean landing station for airplanes, invented by Edward R. Armstrong, head of the mechanical experimental development division of E. I. du Pont de Nemours & Company. Ten years ago Mr. Armstrong, who was

Ocean *on* FLOATING ISLANDS?

By

RAYMOND J. BROWN

the white-clad man who conducted the test of the device, conceived the idea of establishing trans-Atlantic air routes through the use of landing platforms for planes set at regular intervals across the ocean. With this demonstration he presented scientific proof that his idea is not a fantastic dream but a sound, practical conception capable of useful application to the present-day needs of ocean transportation.

He proved, in short, that the landing station he has devised would remain safe, stable and seaworthy under the worst possible conditions of ocean storms—storms that would sink the largest liners in a few seconds. For, although the liner and air station used in the test were exact models of the devices they represented, being constructed on a scale of a sixteenth-inch to a foot and matching the actual vessels in relative weight, displacement and strength of materials, the miniature ocean storm brewed by the wave-making machine was at least twice as severe as the worst Atlantic storm in maritime records. The highest waves ever measured in the Atlantic were between forty and fifty feet. Each inch of wave raised in the swimming pool, though, was equivalent to sixteen feet of ocean wave, and some of the waves developed during the test reached a height of six to eight inches, representing ocean waves of a hundred feet or more.

THE idea behind Mr. Armstrong's invention may be simply expressed. Airplanes designed to carry passengers and freight are incapable of flights of more than four or five hours' duration, that is to say, of more than about 400 miles. For longer flights or swifter flights, the planes must sacrifice carrying power for storage space for fuel and oil. This has been demonstrated on commercial airways in all parts of the world.

As a stunt, a single plane especially



A Dream of Trans-Atlantic Airways at Last to Be Realized?

Airplanes, of course, flying over water, can land on "mother ships" such as naval air fleets provide. But such landings are hazardous, owing to the rocking of the boat. The invention of floating platforms which remain fixed during fiercest storms offers an achievement which may remove the last obstacle to transoceanic air service.

designed and equipped for the flight may make a nonstop trip between America and Europe. Such a plane, though, would be entirely useless for commercial work. To make a trans-Atlantic airway possible, the planes must have mid-ocean landing stations at intervals commensurate with the distance at which the landing fields of commercial land airways are set apart.

Vessels similar to the "mother ships" and airplane carriers of naval air fleets would be inadequate for the purpose, principally because their movements under the force of the ocean waves make the landing of airplanes on their decks a hazardous feat to be accomplished only under favorable conditions. For a commercial service, proceeding under a strict schedule, landings must be effected in any weather and under any condition of ocean disturbance in which the planes arrive.

A MID-OCEAN landing field for airplanes, then, must be a structure that will neither move from its station nor lose its stability under stress of the most rigorous storms, gales and seas.

The problem of producing such a structure occupied Mr. Armstrong for ten years, and the solution he found is in the highest degree ingenious.

To understand the principles on which the "seadrome," which is the inventor's own name for his device, operates, it is necessary to review briefly some elementary facts regarding ocean waves. To begin with, waves in the ocean are accompanied by virtually no horizontal motion of the surface. The motion is vertical, comparable, in a way, with the motion of a tablecloth which is being flapped up and

down by two persons holding its corners.

Also, there is no disturbance of the water at depths exceeding about fifty feet even when the most severe waves are rolling. If a submarine boat, for example, were to be stationed fifty feet or more beneath the surface of the sea while a great storm was raging, its occupants would feel no pitching or rolling.

The seadrome obtains its buoyancy from the cylinders that are mounted on its supports. Floating on these alone, the device of course would rise and fall with the waves just like any other floating body. Mr. Armstrong has designed his seadrome, however, so that about ninety-five percent of its displacement is below the water affected by wave motion on the surface, and the disks on the end shafts, which the inventor calls "dampers," are below the area of disturbance.

In consequence, the seadrome is to all practical purposes constantly in still water. Each time the structure tends to rise at the motion of the waves, the damper disks resist the upward motion like sea anchors. In order for the seadrome to move with the waves, it would be necessary for these disks to lift the tremendous weight of the great volume of water that is resting upon them. The effect, then, is that the seadrome is riveted to the still water under the surface, while the waves at the surface pass harmlessly through the open structure under the landing platform.

THE periodic nature of the rise and fall of sea waves, of course, is responsible for this stability. Were the water to rise or fall slowly and gradually and remain at rest when it reached its maximum or minimum height, the seadrome would rise or fall with it. However, with waves rising and falling rapidly and with regular vertical motion, each time the force of a wave is directed against the seadrome, the damper disks check the structure's tendency to take on the motion of the wave until the force of the wave is dissipated, or at (Continued on page 144)



Demonstration with the miniature seadrome and *Majestic*, emphasizing the stable platform and plunging vessel in a rolling sea.



William Tomkins, right, who after years of study has deciphered a treasury of the mysterious Indian sign language.

When You Beckon with Your FINGER

You Are Using the Sign Language of the Indians--New Studies Tell How to Interpret Their Gestures

By PAUL A. WILLIAMS

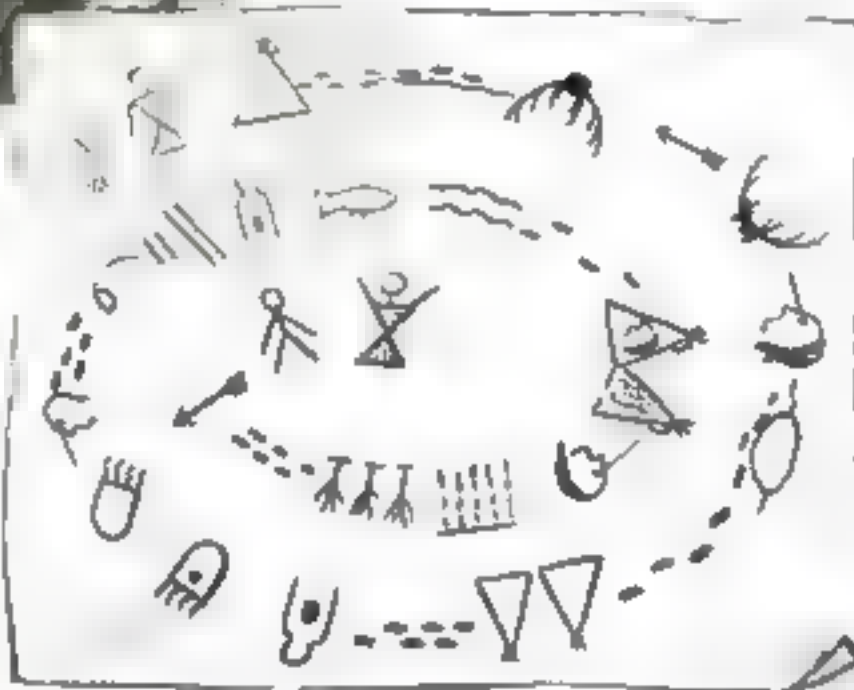
WHILE Crown Prince Gustav Adolph of Sweden was touring the United States recently, he was introduced to one of the most interesting languages in the world—the sign language of the American Indian.

It was at Los Angeles, during ceremonies by which the Prince was installed as a member of the great Arapahoe tribe. Seated on a blanket, surrounded by feathered braves, the future Swedish ruler watched with rapt attention while the tribesmen went through the ceremonial, speaking their silent welcome by means of earnest gestures.

Every one of the gestures conveyed a definite meaning, which was interpreted for the Crown Prince by Colonel Timothy McCoy, one of the few white men who understand the Indian sign language. At once the Prince was impressed by the effective simplicity with which men could convey their thoughts without words.

By coincidence, it was at about the same time that the fascinating secrets of this ancient language were revealed to us all in a book prepared by a man who has spent many years of his life among the Indians of the western plains—the Blackfoot, Cheyenne, Sioux, Arapahoe, and other tribes. He is William Tomkins, of San Diego, California. For forty-one years he has known the Indians and their language. As a boy, working on the cow range on the edge of the Sioux Reservation in Dakota back in the '80's, he made close friends among the redskins. He learned to talk with them, first by the signs understood by all Indians from one side of the continent to the other, then in their spoken languages. Ever since that time he has delved into the romance of America's first inhabitants, their customs, speech, and strange picture writings carved in the rocks.

His knowledge he now passes on to the rest of us in the form of a dictionary, entitled *Indian Sign Language*, of nearly



An Indian Picture Story

TO INTERPRET this story start from the center of the spiral and work around the outer end. Note that each picture has a meaning. Here is the translation:

An Indian and his wife had a quarrel; he wanted to go hunting and she did not want him to go. He took his bow and arrows and started into the forest. A snowstorm came upon him and he looked for shelter. He saw two teepees, but found that one contained a boy with the measles, the other a man with the smallpox. He ran away and shortly came to a river. He caught a fish, ate it, and rested for two days. He started out again and saw a bear. He killed the bear and had a feast. Then he came to an Indian village, but as they proved to be enemies he ran away to a little lake. At the lake he saw a deer. He killed it with an arrow and dragged it home to his teepee, to his wife and his little boy.

800 Indian word signs and their meanings. Most of these signs, like the ones illustrated here, are such wonderfully natural and graphic expressions of thought that they can be learned easily by everyone.

In the dictionary, too, Mr. Tomkins has listed and translated 220 of the strange picturewords which story tellers of the Sioux and Ojibway nations once carved in the rocks or painted on wood or leather. One of these picture stories, with the translation, is reproduced here also.

The Indian sign language, Mr. Tomkins says, has a romantic history unequalled by any other. It is probably the first American language. Certainly it is the first and only universal language. It is

older than the pyramids, and it is the most important gesture language the world has ever produced.

Indisputably it was born of necessity. In North America there were so many tribes, speaking so many tongues, that the continent was an immense Babel. When strange tribesmen met, if they were friendly, they managed to exchange a few simple sentiments by signs with their hands. During years of these occasional contacts, the signs increased in number until a Comanche and an Ohio Indian could carry on a long conversation without uttering a sound except an occasional grunt. Finally, the language grew to such an extent that tribesmen held councils, agreed to treaties, and planned campaigns, all with gestures.

As you look at the signs illustrated on these pages, you'll be surprised to see how natural and understandable they are. At least some of them, you'll say, are exactly the gestures you might use if you had to speak with your hands. In fact, a few of them are precisely the same gestures we palefaces actually use for emphasis.

For instance, who has not expressed the word "done" by emphatically brushing the palms of the hands together? That is pure Indian. And how many times have you said, "Come over here," by beckoning with your finger? That a Indian, too.

Can you think of anything more expressive of "escape" than the Indian way of crossing the wrists, hands closed, then abruptly separating the hands, swinging them to right and left? Even more readily will you recognize the gesture for "give"—hand extended forward and downward, palm upward.

WHILE the meanings of some of the other signs may not be quite so obvious, you'd find it difficult to devise more perfect gestures for the thoughts they convey. Thus, the Indian idea of "mourning" is expressed by clipping with the fingers at the back of the head as though shearing off the hair, then, with the two forefingers, indicating tears coursing down the cheeks.

"Dance" is indicated by raising both

hands, pointing upward and wriggling them up and down quite in the manner of modern jazz singers. Holding the left hand palm upward, and squeezing the tips of the right hand fingers together above it, signifies "powder." Again, the idea of "corn" is conveyed by imitating the act of shelling corn. The left index finger and thumb are projected as though they were an ear of corn; then they are twisted by the corresponding fingers of the right hand.

"Woman" is indicated by making the movement of combing the hair, combined with a feature to indicate height as distinguished from another similar gesture lower down to indicate "girl." To say "book," the Indian would hold both hands in front of him, side by side, palms up, and look at them as if reading. If he continued the same gesture by sweeping his hands apart, he was saying "newspaper."

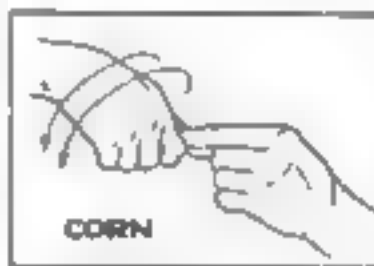
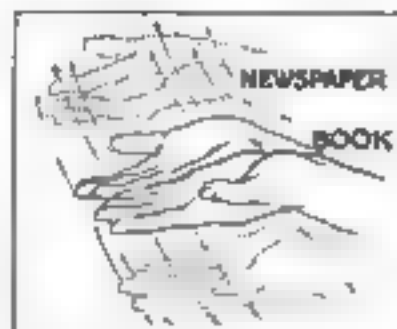
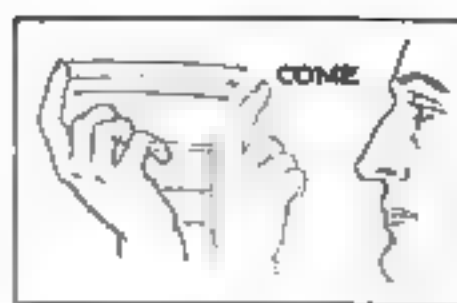
Especially interesting is the way the Indian would combine several signs to indicate one word. For example, to say "the President," he would combine three signs, for "whites," "chief" and "big," and then with the left hand point toward Washington. To indicate "whites," he would make the sign for "color" and then rub with the tip of the right index the small segment at the upper end of the left thumb nail. "Chief" was indicated by holding the right hand at the side, pointing upward, raising the hand in a gradual circle as high as the top of the head, then arching toward front and downward. To indicate "big," he would bring his hands together in front of him, palms in, and separate the hands, bringing them apart but still opposite each other. All this means "President."

Similarly, "Bible" was indicated by combining the signs for "book" and "medicine," "brave" by combining the signs for "heart" and "strong," "bridge" by combining the signs for "river" and "across."

One wide difference between the Indian sign language and the signs used by the deaf and dumb is shown in the word "thank." The originators of the Indian signs thought that thinking or understanding was done with the heart, and made the sign "drawn from the heart." Deaf mutes place extended fingers of the right hand against the forehead, to give the same meaning.

The deaf use a great deal of facial contortion and grimace. The Indians seldom used facial expression, but maintained a composed and dignified countenance, the signs being sufficiently expressive in themselves.

Naturally it is easier to learn to talk the sign language than to read it, for usually a sign sentence is made up of nouns and verbs that have many shades of meaning. The exact meaning of a sign must be determined by other



Some Indian Signs and Their Meanings

That all races have the same emotions and the same instinctive expressions for them is strikingly proved in the gestures the Indians evolved. Many of them we ourselves use every day.

signs accompanying it. Qualifying words, articles, prepositions, and so on, are absent.

Indians never bothered, Mr. Tomkins says, to find signs for "the," "a" and "an." They used the sign for "question" when they wished to ask one, instead of starting off with such words as "what," "where," "why" and "when." If one wanted to ask, "Will you make the fire?" he made the following signs:

Question — you work — fire.

"What do you want?" the Indian would express by the sign words:

Question — you — want.

The words "we" and "they" would be made by the signs Me—a! He—all.

And the Indian's way of saying "he" or "she" was by adding the sign for "man" or "woman." Past tense was indicated by adding the signs for "long time."

These very crudities are the things

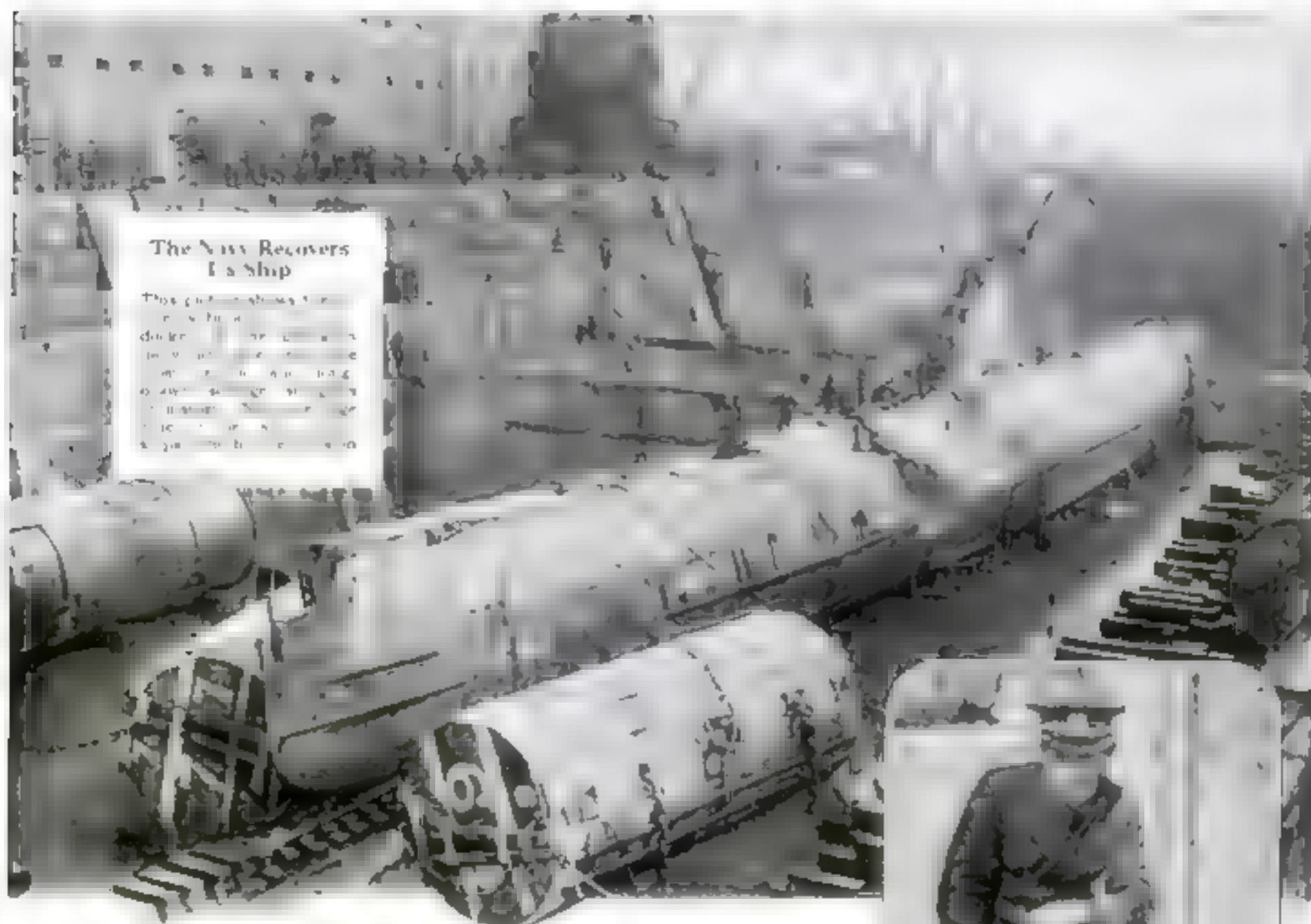
that add charm to this picturesque language. Now that the signs are at last available and interpreted, many people, it is said, are learning to converse the Indian way.

The beauty of this sign talk, Mr. Tomkins emphasizes, depends upon the manner of making the gestures. Movements should not be angular or jerky, but should rather be rounded and sweeping in their rendition. It is inspiring and a thing of beauty, he says, to witness a sign conversation between two capable Indian sign talkers. The few who are left are living in many parts of our country, and, Mr. Tomkins advises, should be cultivated wherever found.



The Crown Prince of Sweden being made a member of the Arapahoe tribe. Colonel McCoy (standing) is interpreting the Indian sign language used in the ceremony.

How Brave Men Cheated *the* Sea



The Navy Recovers Its Ship

The photograph shows the submarine S-51 being hoisted by a crane on the deck of the salvage ship Falcon. The submarine is tilted vertically, and the ship's deck and rigging are visible in the background.

By LIEUT. COMMANDER
EDWARD FLISHER, U.S.N.

Lieutenant Commander Edward Flisher, U.S.N., is shown in the photograph. He is wearing a dark uniform and a cap, and is standing on the deck of the ship.

A remarkably successful recovery of the S-51 was accomplished by the salvage ship Falcon, commanded by Lieutenant Commander Edward Flisher, U.S.N., on the night of June 1, 1926. The submarine, which had been sunk off the coast of Rhode Island, was recovered by the Falcon, and was hoisted by a crane on the deck of the ship.

IN THE darkness, ten feet below the surface, a diver lay in a narrow tunnel. The steel hull of the submarine S-51, sunk off the coast of Rhode Island, was his only light. With muffled hands he held the nozzle of a fire hose, which spat a powerful stream of water to pierce the clay which hugged the submarine fast to the ocean's bed.

Now he reached a point fifteen feet from the entrance of his burrow—no light, no sense of direction except the feel of the buried submarine's metal hull against his back.

The diver was Chief Torpedoman Francis Smith, U.S.N. Clad in clumsy diving armor and helmet, and kept alive by a stream of air from above, he worked

on. He was trying desperately to complete a hole through which heavy lifting chains might be passed beneath the grim tomb where thirty-three valiant sailors died in September, 1925, after a collision with the steamship *City of Rome*.

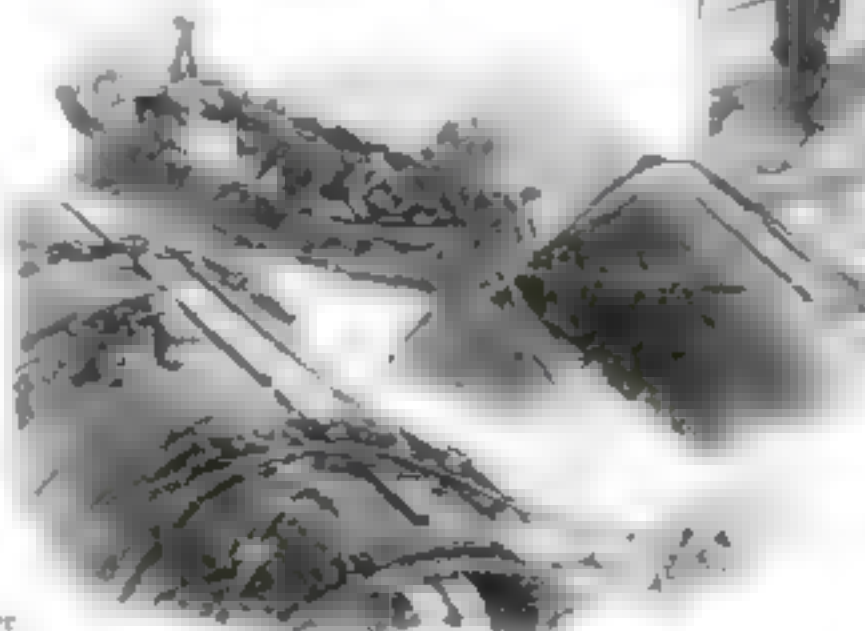
Twenty-two fathoms above, we on the salvage ship *Falcon* waited anxiously. A sailor listened on Smith's telephone. Suddenly he heard a sound from below.

"I seized his telephone and ordered him to go to Smith."

Again I called to Smith: "Shall I turn off the water?"

The reply was a scream: "No, for God's sake no, keep it going! The tunnel has caved in behind me!"

On deck we looked at each other, aghast, but the next instant Eiben called up that he was— (Continued on page 140)



When the diver reached the submarine, he found it fast to the ocean's bed. He worked for several hours, and finally succeeded in freeing the submarine. The submarine was then hoisted by a crane on the deck of the ship.

The New Wonders of Our SUN

Exiles on Lonely Desert Mountain to Study Vast Power Plant of the Sky

By WILLIAM J. WHITE, JR.

IN A cave on the desolate summit of Mount Brukkaros, in the heart of a desert waste in southwest Africa, two American scientists soon will begin a most extraordinary vigil. In endless solitude, sixty miles from the nearest town of any size and six miles from the closest Hottentot village, they will spend their waking hours, day after day, with delicate instruments studying the mysteries of the sun.

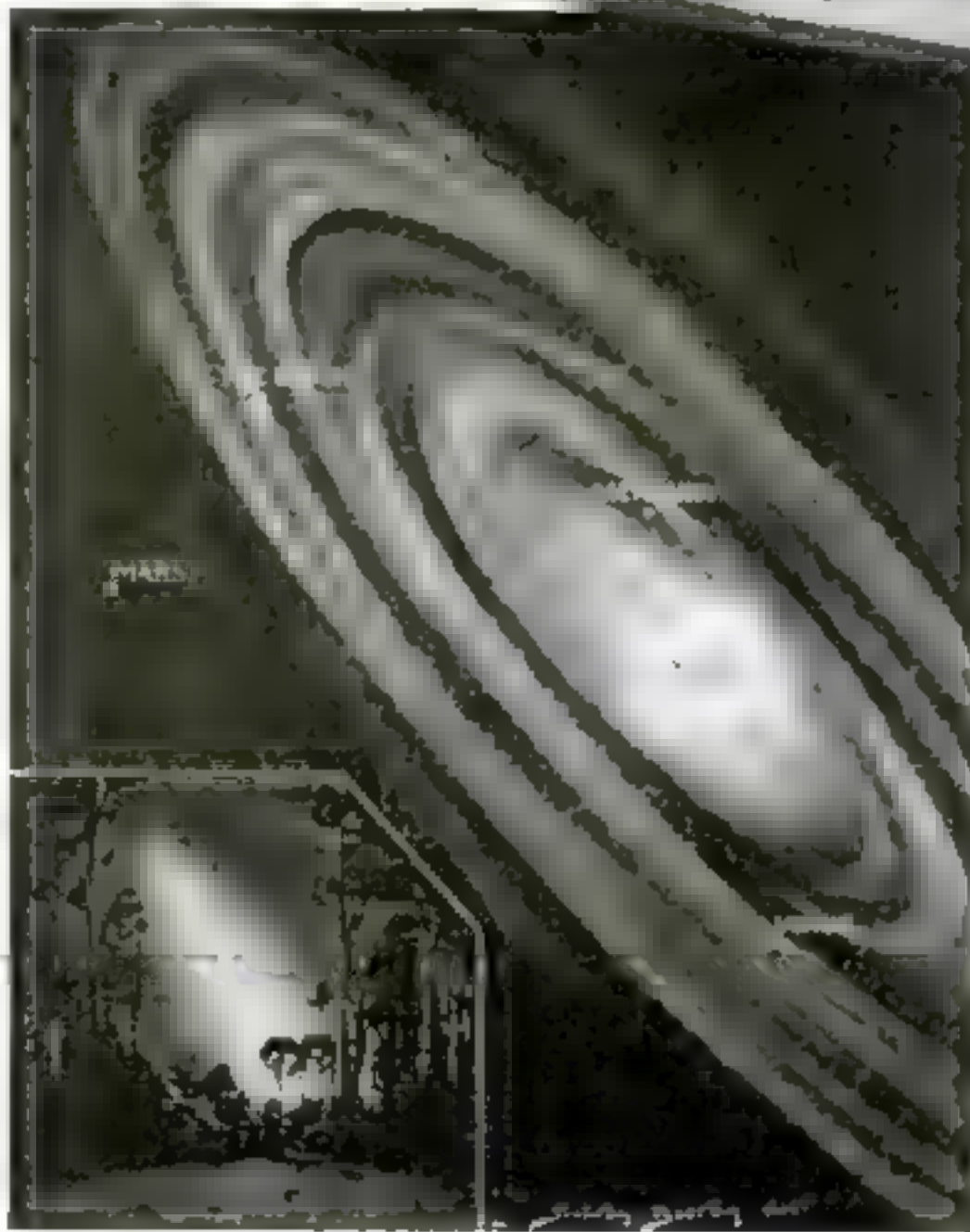
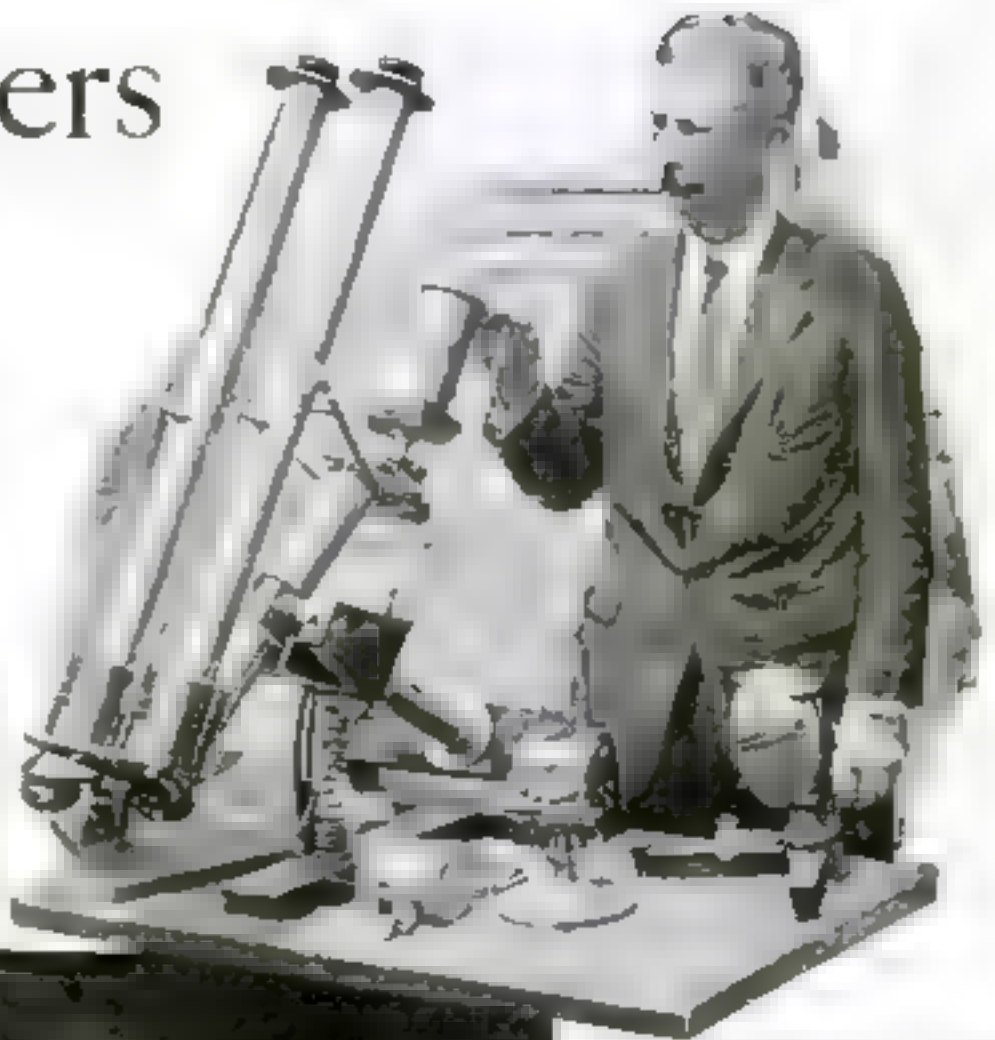
Patiently they will keep at it. For in their strange vigil they will be inspired by the hope of wresting from the face of the sun new secrets of energy and radiation which may be of untold value to future generations.

The names of these scientists are William H. Hoover, head of an expedition sent out by the National Geographic Society in cooperation with the Smithsonian Institution, and Frederick A. Greeley, his assistant.

AS YOU read this, they have embarked on a 10,000-mile journey by ship, railway, auto and burro to the mountain island in the desert, which will serve as the strangest observatory to be found anywhere on earth. With them is a sixteen-month-old baby, Mr. Hoover's daughter. With them also are thirty-five cases containing marvelously delicate astronomical instruments, fifteen cases of photographic plates, a gasoline engine to generate power for the instruments, a gasoline stove, cooking utensils, books, a phonograph, and a large number of records. All these, in the final stage of their hazardous journey, they must transport over mountain passes called "the most desert spot in a desert."

This dreary observation post was established a few months ago by Dr. Charles G. Abbot, director of the astrophysical laboratory of the Smithsonian Institution, who for more than thirty

Dr. Charles G. Abbot, Director of the Smithsonian Institution's Astrophysical Laboratory, with the sun gazing, one of the remarkable measuring instruments which he has prepared for the sun's radiations.



A Vast Sun Belt—Does It Affect Our Weather?

Astronomers who have observed this enormous ring of light encircling the sun believe that it is a flat ring of matter somewhat like the rings of Saturn, extending more than a hundred million miles into space, far beyond the earth. The smaller picture shows how it has appeared from the earth after sunset—a faint, comma-shaped band of light stretching up from the western horizon. Spectroscopic observation indicates that it is composed of solid particles shining by reflected sunlight.

years has studied the sun and its mysteries. Here the two scientists acting as Dr. Abbot's outposts will face months of isolation in the wilderness to carry on his attempts to solve for mankind the riddles of the fiery power plant of the sky.

For ages men have thought of the sun

as a tremendous giver of warmth and light. But is it always so dependable, or do its radiations vary from day to day? If so, how do these variations affect our weather and our daily life on earth?

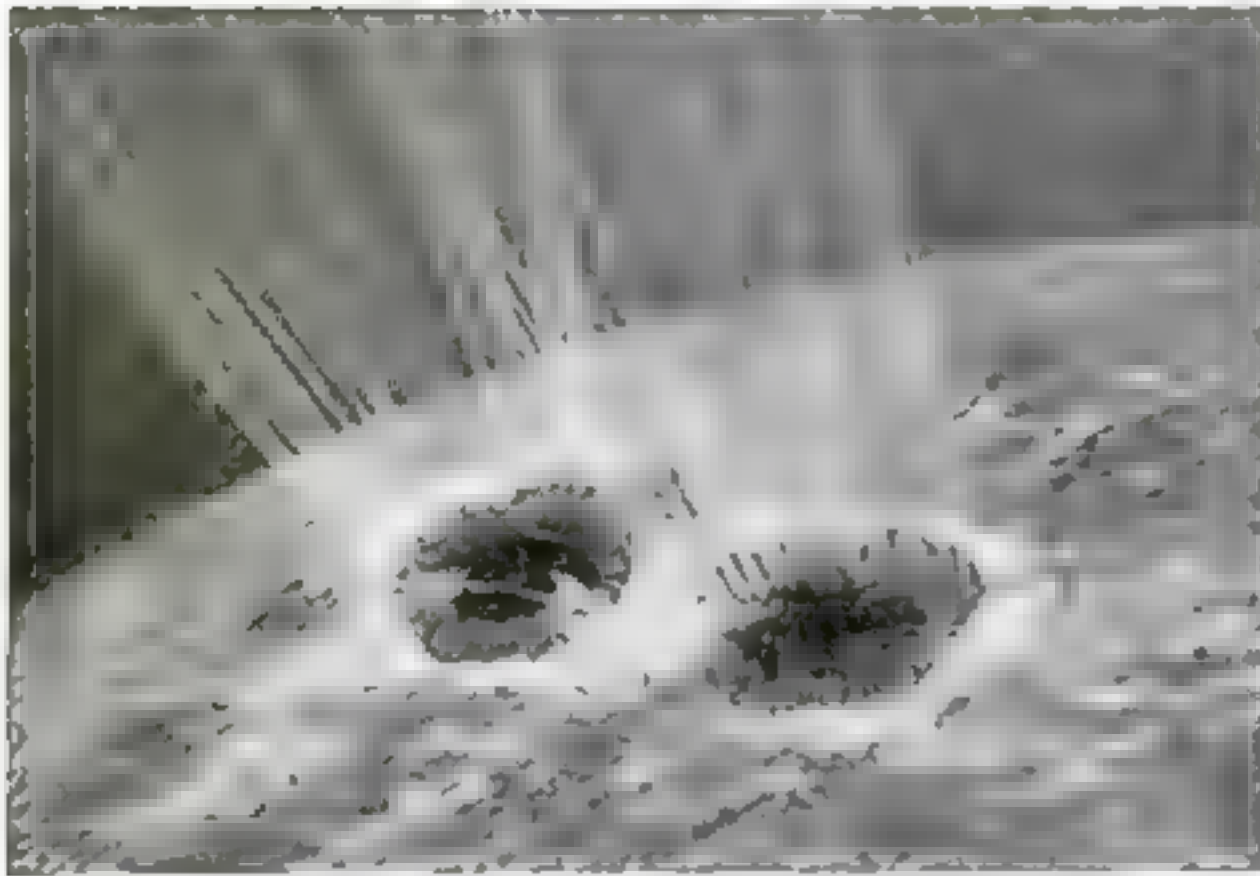
Right now the face of the sun is passing through one of its periods of eruption of sunspots, which began earlier. Just what are these spots, and how do they influence us?

WE KNOW that the sun is a tremendous power plant, generating billions of horsepower every second. Can we ever learn to turn this endless source of power to run our machinery? And if so, how?

These are a few of the questions which science seeks to answer. As for the first of the questions, the constancy of the sun, Dr. Abbot already has established the fact that the sun's radiations do vary from day to day. In his years of experiment he was one of the first scientists to advance the theory that these variations affect our weather.

To test his theory, Dr. Abbot established two observatories in the western hemisphere—one at Calania, Chile, and the other atop Mt. Harqua Hala, Arizona. Both of these places were selected because of the slight rainfall and the clarity of the atmosphere. Each day the sun's heat is recorded at both places, and from that the solar constant is figured. This impos-

hemisphere—one at Calania, Chile, and the other atop Mt. Harqua Hala, Arizona. Both of these places were selected because of the slight rainfall and the clarity of the atmosphere. Each day the sun's heat is recorded at both places, and from that the solar constant is figured. This impos-



Huge Pimples on the Face of the Sun

The sun spots, which are believed to affect our weather, are immense volcanoes which shoot great rivers of superheated gases far out into space, and bombard the earth and other planets with showers of electrical bullets. According to one theory, they are produced by gigantic whirlpools set up between the moving layers of gases within the sun. One of these spots observed last January was found to have a diameter of 40,000 miles or about five times that of the earth. Scientists are trying to learn the reason for these spots.

ing term means nothing more than the heat of the sun that would be recorded on a thermometer located outside the great bag of atmosphere that surrounds the earth. The figures from both stations are then telegraphed to Washington. They have been found strikingly alike when compared daily, while the change in the figure from day to day has proved to Dr. Abbot's satisfaction his theory that the sun's heat fluctuates. The next thing to determine is how this variation affects the weather. Given that, long range forecasting will be an actuality.

BUT first Dr. Abbot wanted a further check on his theory. Possibly the stations' figures were much the same because they were located so near to each other. He decided to seek a dry spot in the eastern hemisphere.

With that end in view he left Washington a year ago for a trip around the world. One site after another was discarded until he reached Mt. Brukkarok.

Men like Dr. Abbot who are making the sun their life study believe that if they can solve the mystery of the sun spots the rest will be easy. Why do these spots vary in numbers? What is the explanation of the eleven-year cycle of their appearance?

If you take a baseball in your hand, twirl it, and watch the stitching travel in a sort of arc toward the center and then away from it, you will have a fair idea of the motion of the spots across the sun's face. They first make their appearance at the upper edge, but have no effect on the earth until they reach the central meridian. When they are sixteen degrees north or south of the sun's equator their effect on us is the greatest. Then they pass out on the other side. But if large enough they may appear again when the sun has completed his round, which takes from twenty-five to thirty days.

Many of these spots are large enough to be seen without the aid of a telescope,

using, of course, smoked glasses or a piece of densely fogged photographic film as protection for the eyes. The large spot observed in January last had been visible on several previous rotations. When it reached its period of greatest intensity it was found to have a diameter of about 40,000 miles. If five worlds the size of ours had been lined along just one half of that crater they could have all been pushed in at one time without touching one another.

What causes these tremendous volcanoes? Scientists would give much to know the answer. It is now pretty generally believed that the sun is made up of a number of layers of gases—all in motion, but at varying speeds. Dr. J. H. Jeans, the British scientist, believes that these layers rotate faster toward the surface, just the opposite of the action of the earth.

The different speed of these layers has the effect of setting up whirlpools or vortices. If you stand on the rear platform of a train you will notice bits of paper swirling in its wake, the result

How Astronomers Study the Sun

A partial eclipse of the sun, as seen through the giant telescope at Harvard Observatory. It is during eclipses, when the moon passes between sun and earth, that we gain our knowledge of solar wonders.

of the partial vacuum caused by the swift passage of the train. In any body of water where there is a swift current, or currents of varying speeds, such as Niagara Gorge or Hell Gate, New York, whirlpools are set up. The same phenomenon is believed to happen in the sun.

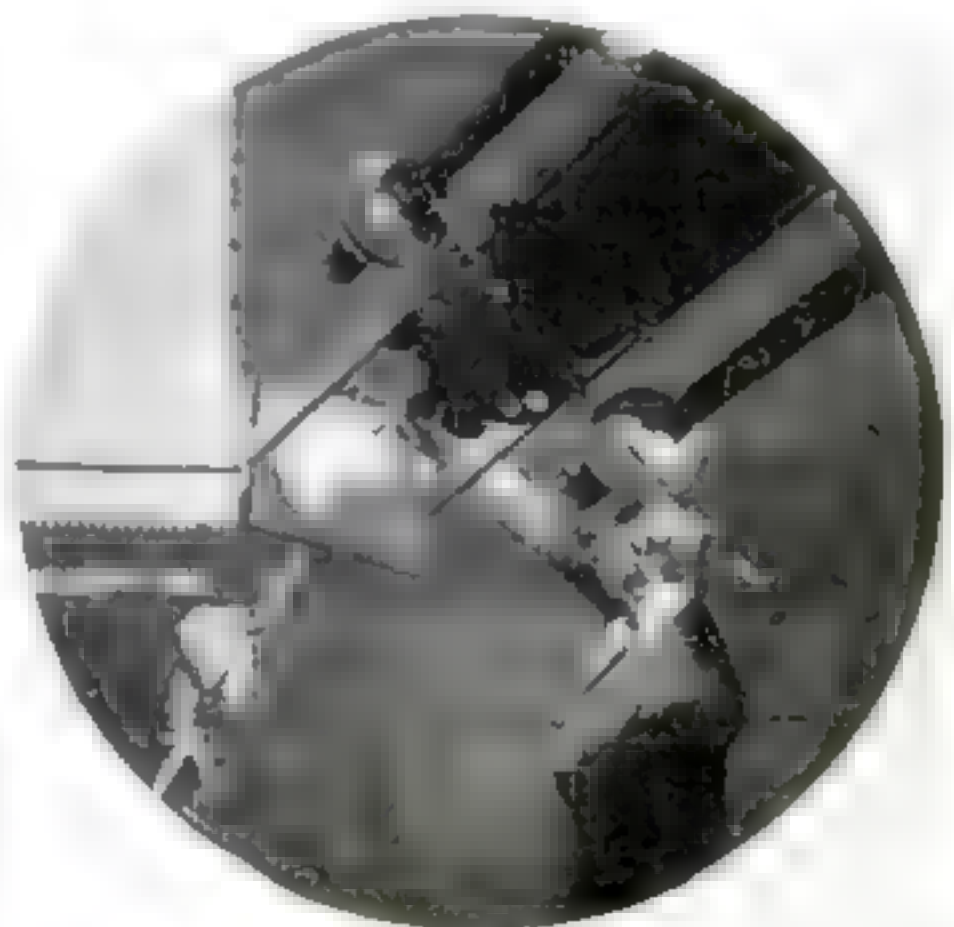
BETWEEN each pair of layers an immense vortex is created, extending clear around the circumference. With the increase in friction this whirlpool grows and seeks an outlet. The tremendous energy finally forces openings through the top layer of the sun, in the same way that water whirlpools become waterspouts. Out shoot great volumes of gas which continue to pour forth until the internal pressure has been relieved. It's just as though the sun had occasional stomach aches caused by the formation of gas. When that pressure has subsided to the extent of being less than the weight of the sun's outside layer, the breach closes up.

These spots seem to travel in pairs, one on each side of the sun. The motion of the gases in one is always the opposite of the other. Here's the way that is explained.

If you draw an oar blade through the water you set up a tiny whirlpool. Close examination will reveal that the direction of the whirl where the oar leaves the water is opposite to that of the point of entry. It's the same principle exactly in the sun. Follow that great vortex around the circumference from the first break to the other, and you'll see how the direction of the twist changes.

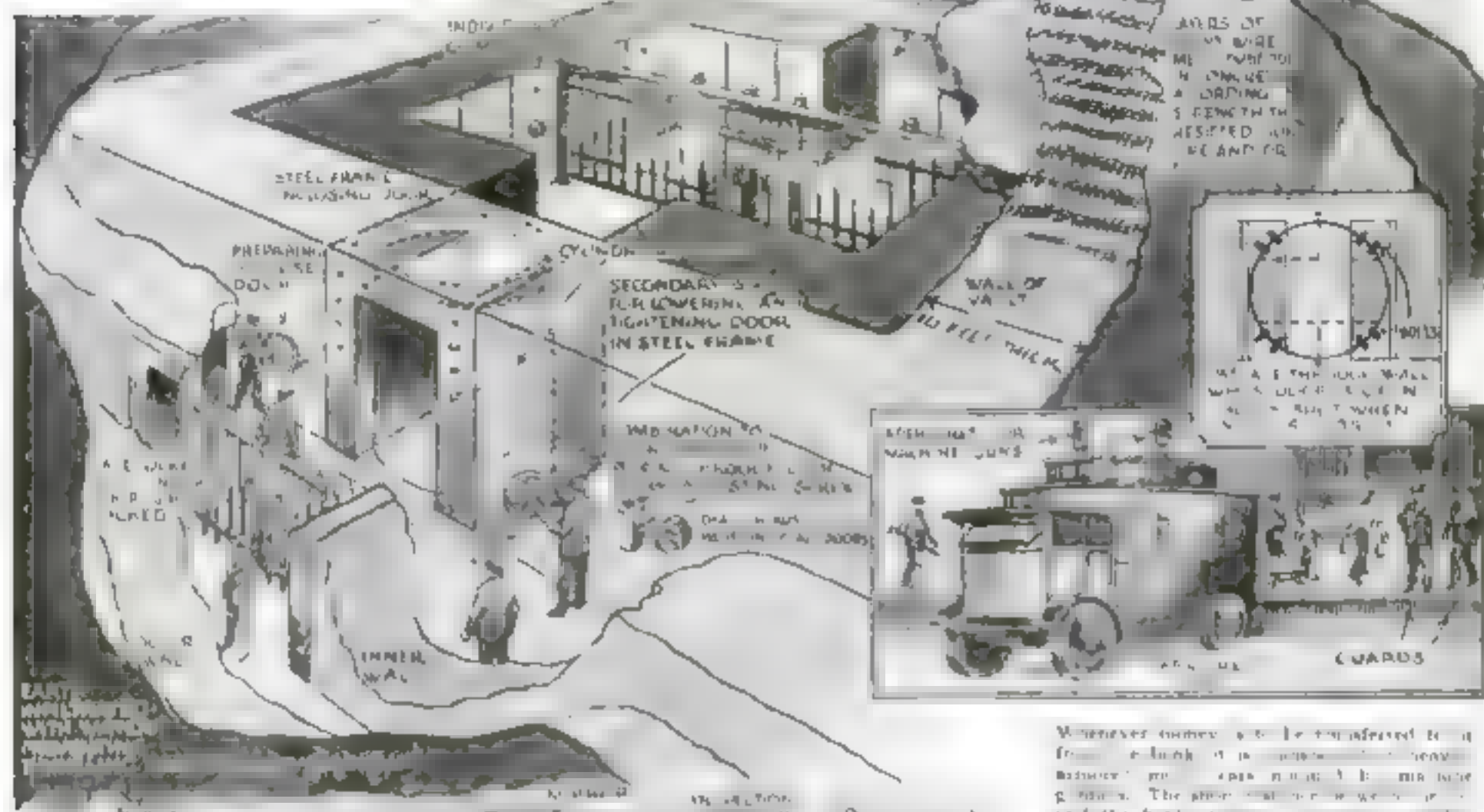
POSSIBLY you and your friends were disappointed with the performance of your radio sets last winter. The trans-Atlantic tests were a complete failure. All that, the scientists say, is chargeable to the sun spots. It has been known that they affect telegraphic and telephonic communication—on a day last January operation on almost all long distance lines was virtually suspended for an hour—but the effect of those solar volcanoes on radio broadcasting was principally a matter of conjecture until last winter.

But these dis- (Continued on page 14N)

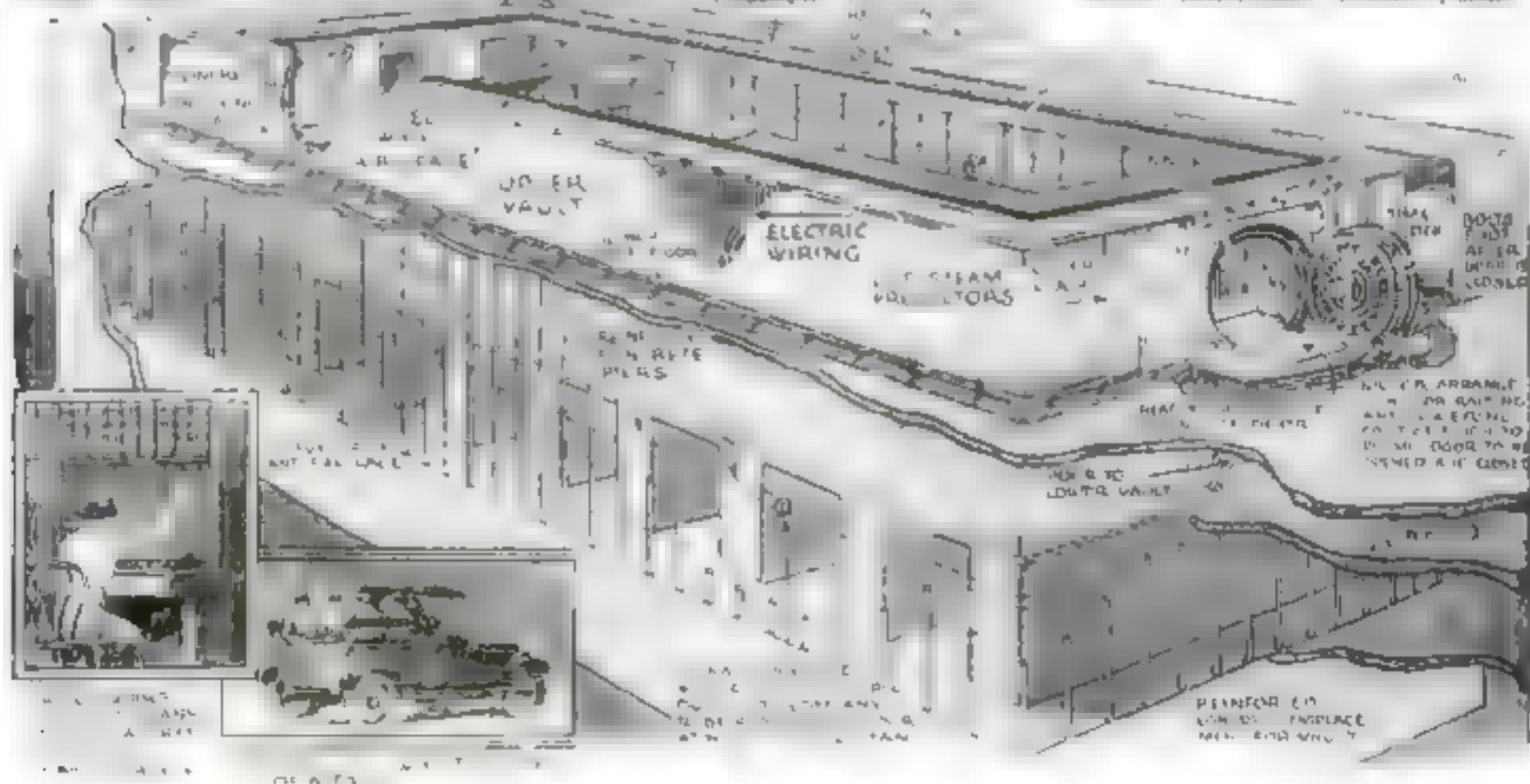


Why Your Money Is Safe in a Bank

AN EXPERT safe-cracker wouldn't have a chance to break his way into a modern bank vault even if he possessed complete plans. According to the drawings on this page showing a cutting through the walls in two of our great cities, our artist graphically shows the reasons why



Whenever money is to be transferred to it from a bank it is carried in heavy armored cars. The armored cars are built of steel and the bulk of the car is made of steel.



Steel Walls, Secret Alarms and Deadly Defense Appliances Defy Boldest Cracksmen

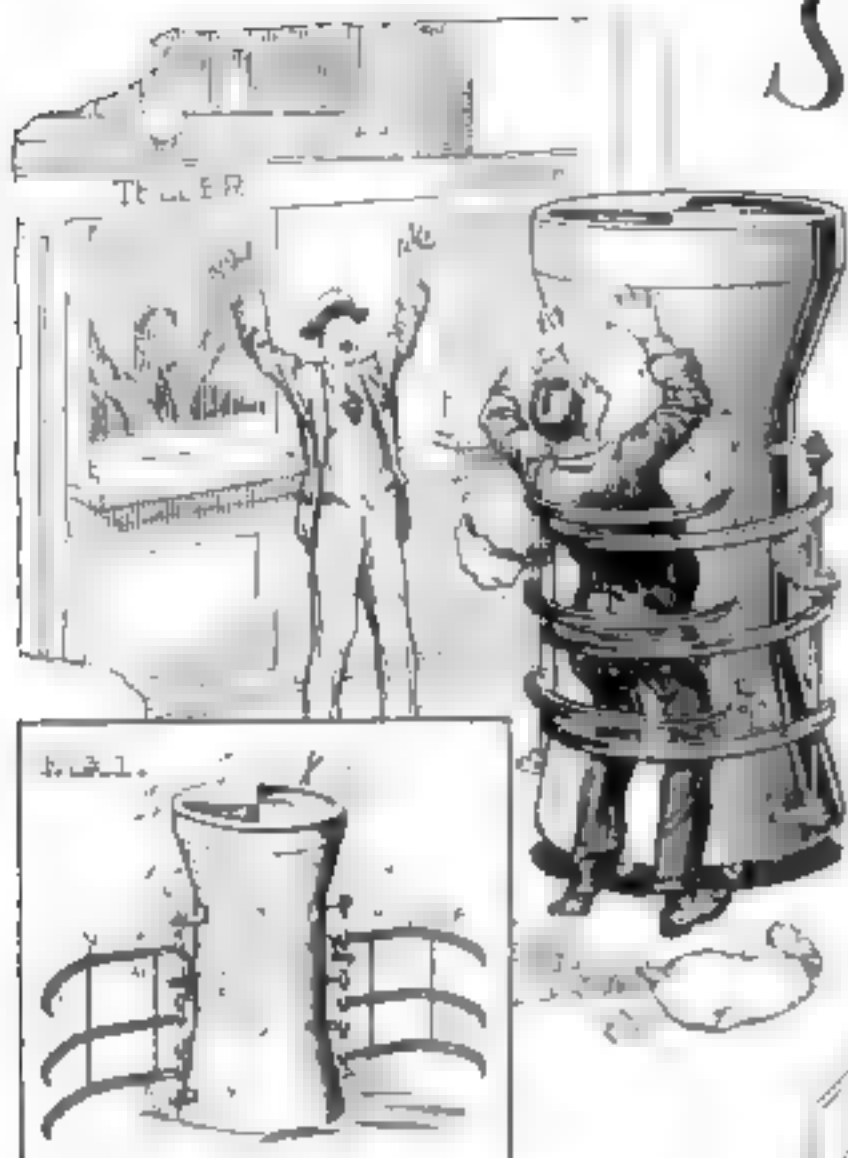
In repelling any attack of invaders, these great strongholds that safeguard your money offer a triple line of defense. First of all, the vicinity of the vault is patrolled by armed watchmen, guards and detectives. Second, electricity stands always ready as a swift courier to flash an alarm that will

summon help in case of attack. And finally, the vault itself is a veritable fortress of special alloy steel which will withstand the most powerful weapons which cracksmen can employ. Tough inner and outer walls, and massive steel doors that are locked and unlocked by two different sets of

men, make the repository virtually impregnable. As supplementary precautions, there have been installed such deadly devices as projectors of live steam which, if necessity arose, could turn the interior of the vault into a terrible cauldron where it would be impossible for a human being to survive.

Some Queer Ones

Uncle Sam's Records Reveal

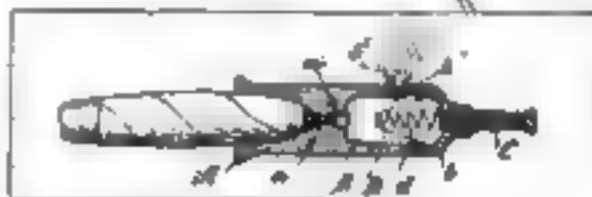


Frightful Trap for Bank Bandits

The armored mechanical monsters of wartime must have furnished the inspiration for this fearful man-catching tank, by means of which "the burglar may be chased, grabbed, and held safely until assistance arrives." It bears the patent number 1,392,095, issued in 1921. Armed with cruel steel talons, and propelled by a storage battery electric engine, it was designed to charge over the floor on small wheels in pursuit of the robber. When the fleeing culprit is within its grasp, a watchman concealed within the sheet metal armor turns a crank. The talons close upon the victim with deadly grip. The watchman then presses an electric button to summon the police. In the metal armor are numerous peep holes through which the occupant may aim and shoot.

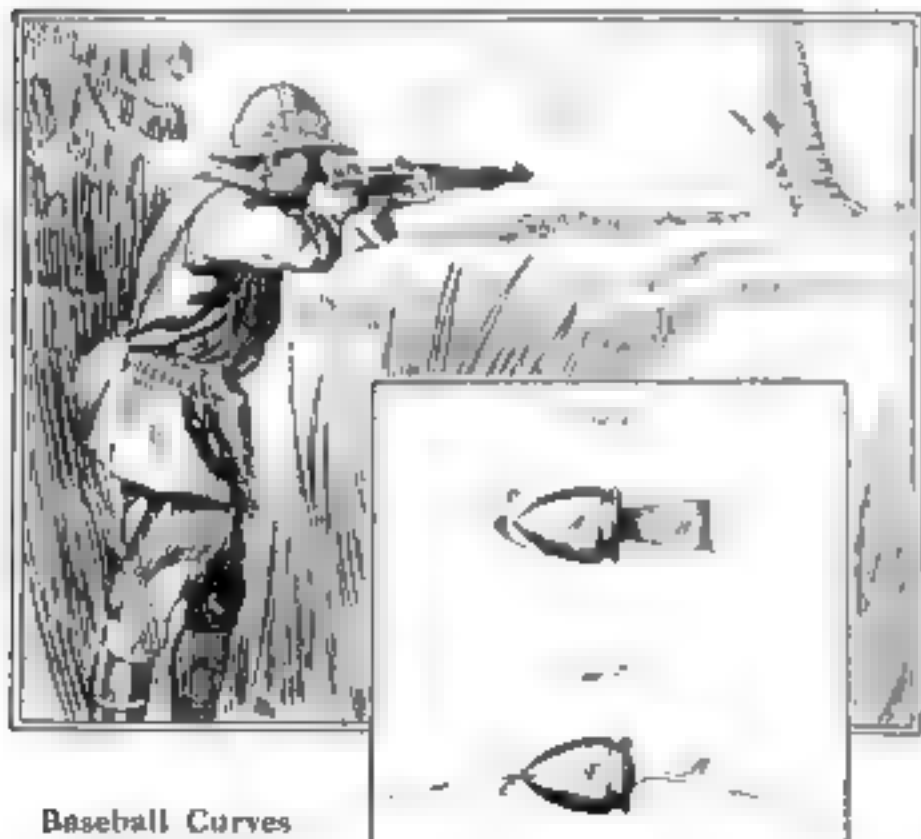
An Expurgated Smoke

Back in 1894 an inventor reached the conclusion that "the principal enjoyment of smoking is in the fragrance of the cigar and not in the smoke, nicotine and deleterious elements drawn into the mouth." So he devised this ingenious cigar holder to keep smoke from the mouth. Section on the stem C acts on the diaphragm D, which draws smoke from the cigar into the chamber B. The smoke is discharged through outlet valve B'.



Why Not Eat with Your Feet?

The originator of the ingenious eating machine shown at the left originally intended it as an aid to armless cripples, but suggested also its value to the business man who likes both hands free to read the morning paper. There is a lever with a fork at one end and a weight at the other. The fork end is connected by cable with a treadle. Foot pressure on the treadle plunges the fork into the desired morsel. When the foot is raised, the weight lifts the fork to the mouth of the busy diner.

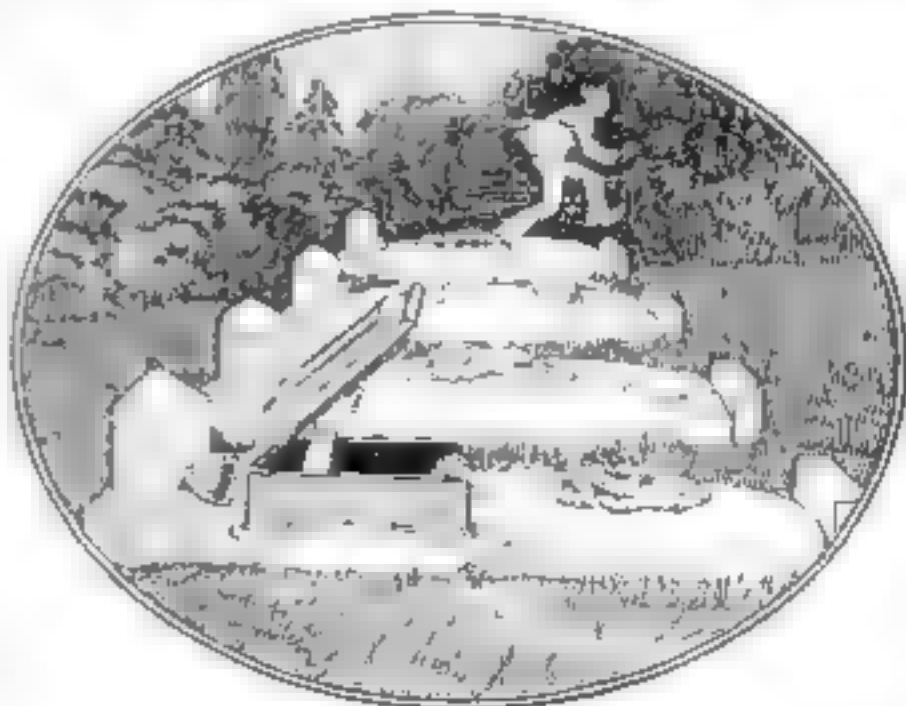


Baseball Curves for Marksmen

The habit of savages of fighting from ambush suggested the idea of a boomerang bullet that would curve and hit a mark behind a tree. Attached at the rear of the bullet (A) is a curved rudder (B), while at the nose of the bullet is a projecting fin (C) set at the same curve. You can see how a marksman of uncommonly keen judgment might learn how to aim wide of his target and hit it.

For the Corpses That Doesn't Stay Dead

To allay the terror of being buried alive, Frank Vester patented in 1898, the elaborate safety coffin pictured below. From the lid of the coffin up to the surface of the grave runs a square exit tube with hinged trapdoor at the top. In the tube is a cord fastened to the bell at the top, and a ladder. Now suppose the deceased comes to life. If strong enough, he can climb the ladder and escape. If too weak to climb the ladder, he can simply pull the cord and ring the bell, sounding an alarm to summon the caretaker of the cemetery to his assistance.

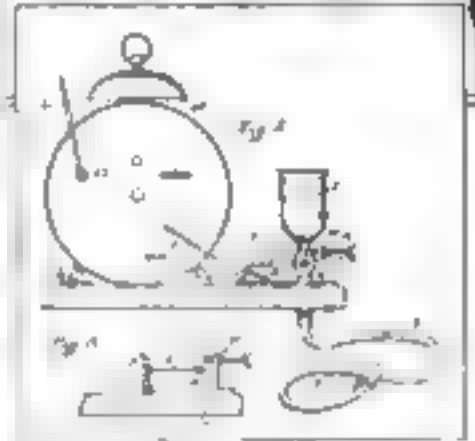


from the Patent Office

Many Odd and Unusual Inventions

A Water Cure for Late Sleepers

Sudden awakeners, such as the patented alarm clock device for hurling the late sleeper out of bed, pictured in last month's issue, were considered too shocking by the originator of the apparatus at the right. He rigged up his alarm to let loose a stream of cold water running from a faucet through a perforated tube about the sleeper's neck. The worst possible effects, the inventor figured, would be to give the sleeper a morning bath, and perhaps induce troubled dreams of shipwreck or drowning.



Breath Quenches Thirst

Lurid tales of the shipwrecked sailor's cry for "Water!" evidently stirred a New York inventor who, in 1923, patented a scheme for replenishing the rancors by condensing the sailor's own breath. The idea shown at the left, was to "subject the human breath of exhalation to condensation, and collect and store the condensate for use as a method of relieving thirst where drinking water is not available."

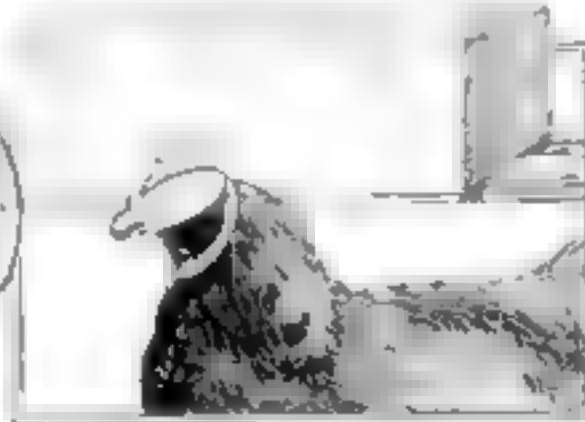
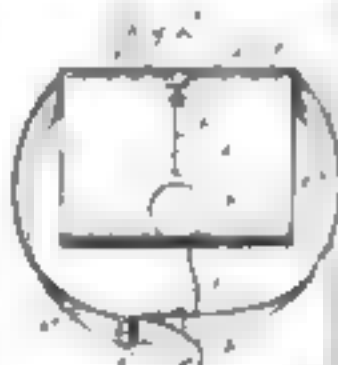
Cute Lips While You Wait

It was early in the present wave of mechanical beauty that a woman perfected this machine to produce the most perfect "Cupid's bow" lips without resorting to surgical operation. The business end is a clamp of the desired contour. You fasten it to the upper lip by pressing a lever. The longer you keep it there the more aluring is the pucker.



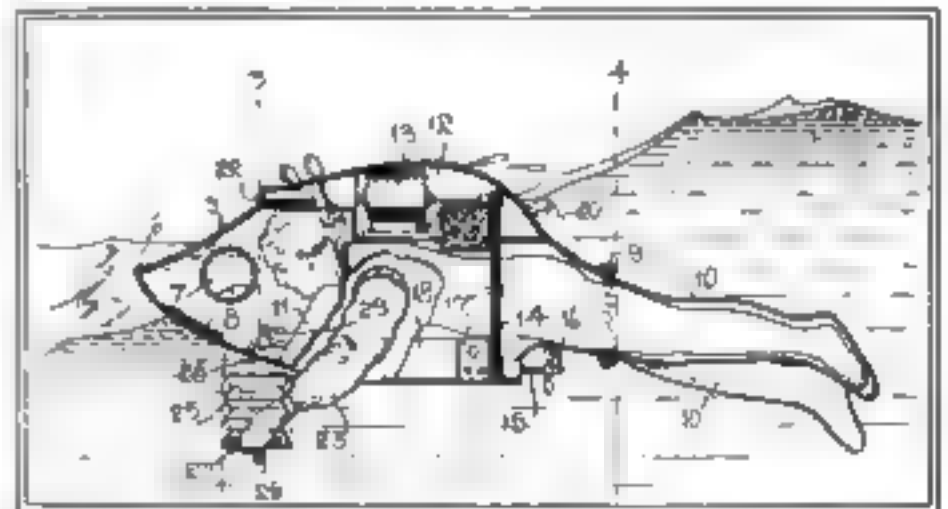
A Mechanical Whip

Possibly the success of the automobile accelerator suggested the idea for a mechanical whip, below, patented in 1914. Here the whip is held in a socket adjacent to the desired point of application, and operated through a chain drive by a lever at the right of the driver. Each pull on the lever brings the whip down. Undoubtedly, it possesses the advantage of pounding at the nag always in the same spot.



How Can She Set?

There have been innumerable schemes to keep hens from trying to set, from rooping Biddy in a barred cul to setting her down in a pan of cold water. This invention, though, provides for a blind strapped over the eyes of the old bird so that she can't look upward to find the nest. The patent is shown at the left.



One-Man Submarine Built Like Turtle

A man from Denver, Colorado, invented this one-man submarine in 1918. It is shaped like a turtle, and, the patent papers say, is "substantially in the nature of a diving suit." An electric motor (13) connected with the propeller shaft (15) drives the ship. In submerging, a bellowlike receptacle (25) is collapsed, forcing the air into a tank (18). The legs and arms, enclosed in flexible rubber, can move freely to guide the ship. The hull is fitted with windows (7 and 8) and an electric headlight (22).

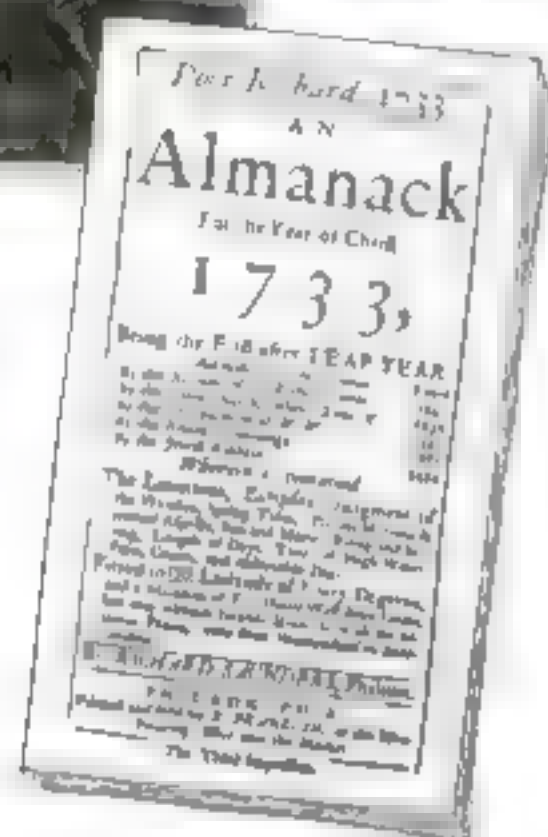


Franklin the Printer

This fine print (a Thistle print, copyright the Detroit Publishing Company) shows Franklin at work in his print shop. Below: The title page of Poor Richard's Almanack for 1733, showing much space devoted to scientific subjects.

The Romantic Story of Franklin America's First Great Experimenter

*How His Curiosity Put the
Gulf Stream on the Map*



BENJAMIN FRANKLIN'S face, on our one-cent stamp, is as well-known as "In God We Trust" on our silver money. It is the face, not of one who "launched a thousand ships," but of one who once had a great deal to say in deciding where a lot of ships should, or should not, be sent. In fact, there is good reason for saying that but for Franklin two centuries ago there might have been a considerable difference in the history of New York City as a world port.

He was Postmaster of Philadelphia at the time. Ex-Governor Spotswood of Virginia, as Colonial Postmaster-General, had appointed Franklin his deputy.

Complaints from the Colonies, made to the London Lords of the Treasury, protested that packet ships from Falmouth needed fourteen days more for a voyage to New York than merchantmen required to sail from London to Rhode Island. No sooner had Franklin heard of this, than his eight-cylinder mind began pounding out the question: "Why? The ships are just as fast, and there is very little, if any, difference in the distance. Why should it take longer to New York?"

Naturally, with him, the next step after asking a question was to get the answer. Calling it "an odd situation," he sat down to write everyone who might give him an explanation. Among his correspondents he included some old sea captains and one of these, a Nantucket whaling-man, wrote back promptly.

"There's a current in the ocean," he said. "If you leave Falmouth and want to make New York, you have to cross that

By
ARCHIBALD DOUGLAS TURNBULL.

current and make allowances for it. Any whaler knows that, but these packet smokes, even if we tell them about it, won't believe it. That's where the trouble lies."

Of course, the old skipper was right. The gulf stream lay across the Atlantic lane where it could not successfully be ignored. Immediately, Franklin began collecting every possible bit of information he could find about it, and also began seeing to it that this information was spread around where it would do the most good.

HE WAS instrumental in having a diagram of the stream and its course made, with the result that it soon appeared upon all Atlantic charts. After he had stood the egg on end as it were, anybody could crack it. With a proper calculation on the stream it was a mighty poor navigator who could not cut his running time from England to New York. And New York retained its supremacy in trans-Atlantic shipping over the Rhode Island ports.

To explain the stream, as he had to do for his own satisfaction, Franklin declared that it was due to an accumulation of water on the eastern coast of America, piled up by the trade winds. On some of his own voyages he had noticed a difference in the color of the water, as well as weeds in the stream, which, as he put it, was "warm and did sparkle at night." Moreover, he had put overboard a ther-

mometer and recorded a long series of temperatures, to prove that he was dealing with an independent current. Tracing its course up the coast, he contended, correctly enough, that the warm air of the stream, meeting the colder Newfoundland atmosphere, caused the fogs with which that region was infested.

Altogether, his was a considerable contribution to hydrography. Such interest in the gulf stream is all the more remarkable because, from the time he became Postmaster in 1737, it would seem that he had enough to do with his efforts to hire faster post riders, reduce postage rates, and work as earnestly as he did work to improve the whole mail service.

The truth is that he could never be drawn wholly away from thinking about the sea. As a Boston youngster, when his father, old Josiah, was planning to make him a preacher, he himself was just as determined to run away and "go for a sailor." Just as his father's plan was realized in a sense—since the son did become a practical preceptor of every man's religion—so his own young hopes were fulfilled as far as keeping him always interested in the sea, its phenomena and its mysteries.

ON ONE occasion, when he was afloat with "a fleet of ninety-six sail," he was struck by the fact that two of the ships seemed to be leaving wakes much smoother in appearance than those of the other ships. When he asked about this, he was told by the captain of his own ship that these two ships had just thrown over-

board the greasy water from their galley pots. To a mind like Franklin's, this reply was just suggestive enough to raise the next question, "Well, what does that prove?"

Some years later the incident was brought back to him when he heard that a certain ship, pitching and pounding in a furious sea, had dumped a few gallons of oil overboard to get rid of it.

"What happened?" demanded Franklin.

According to the report, it appeared that the oil had had the surprising effect of smoothing down the angry crests of green rollers and materially easing the struggles of the ship. "Oil on troubled waters" immediately took on a practical significance for Franklin, and off he strode to the nearest lake, a bottle of oil in his capacious coat pocket.

THE breeze was rippling the lake's surface when he arrived. Taking out his bottle, he sprinkled a few drops here and there. As the oil spread, he noticed with delight the prismatic color which was reflected, but he also noted that there could be little doubt of the effect upon the ripples. First from the beach to leeward and then from that to windward, he went on sprinkling. Even under the fresh breeze the oil, spreading sluggishly, wiped out the ripples. The "slick" was perfect.

Proceeding in his careful way to make notes of this experiment, Franklin immediately expanded these into a letter in which he maintained that the same effects would be produced on the open ocean. His obvious deduction was that a ship, by using oil, could make an artificial lee for herself. Franklin argued that it would be a simple matter for any ship to carry enough oil, since so little went such a great way, for use in a storm; and that it would be equally simple to dump it overboard through the scuppers.

So delighted was he with his conclusions that he carried a little oil in the hollow of his bamboo cane for a long time afterward. On his walks about the country he would stop at any river or bay to demonstrate for his companions the value of the oil.

Strictly speaking, perhaps, this was not his discovery, but he certainly rediscovered, and, as was his way, proved to his own complete satisfaction the quality of "this friend of the blue-water sailor." What was more—he gave it publicity.

NOWADAYS, not a winter passes without its tales of lifeboat rescues made possible only by the oil slick first spread in a carpet between some liner and a derelict tramp or schooner the crew of which had been clinging for hours to frozen remnants of rigging.

As another means of helping a ship in a heavy seaway, Franklin devised two types of what he called "swimming anchors," now better known as dragues, for the purpose of holding the ship's head to the wind and thus presenting the smallest possible resisting surface.

One of these anchors took the shape of which he was rather partial—that of a

kite. The other was more complicated, consisting of a number of ribs "in the form of an umbrella" over which "four-square canvass sail" was to be stretched. Spread open, and attached to the end of a long bowline from the ship, this would offer considerable resistance. To turn or "spill" it, and thus make it easy to haul back on board, it was fitted with a small lanyard. In other words, to all intents and purposes, it was a water parachute.

The three requirements which Franklin

If Franklin Were Alive Today

OF ALL the Colonial fathers—Jefferson, Adams, even Washington—none of them would find himself so completely at home in our times, if he could come to life again, as always-inquisitive old Ben Franklin. He is distinctly of our own day, as Mr. Turnbull's fascinating serial romance serves again to show. This is the second installment of this four-part story; the third will appear in next month's issue.

listed for these anchors were as follows:

1. Resistance to the sea, sufficient to hold the ship's head "up" or to windward, and causing the anchor itself to drift but slowly to leeward.

2. Must be capable of being placed below the "wave" of the sea, but not below the undertow.

3. Must not take up much room aboard ship and must be easily handled.

Today every patent drague, as well as every hastily improvised one, dropped



Electric machine still in existence, used in Franklin's experiments two centuries ago

overboard by a vessel broken down or caught, short of fuel, by a gale, must meet these essentials.

All this, with a number of other proposals, was embodied by Franklin in a long letter to M. Le Roy, a friend in Paris. Speaking of the attention which had been paid to the form of hills, or "stream lines," he suggested similar attention to the cut of sails, in order that they might offer a minimum resistance to head winds. On the theory of smaller sails and more of them, he drew his design of a rather extraordinary rig, vaguely suggesting what is now called the "slating Gutter" and used for ship's cutters.

IN A letter he made a sketch of the manner in which a ship's hemp cable could be parted because of the heavy strain resulting from a right-angled bend or "elbow," and suggested as a remedy a pulley wheel in the hawse pipe.

To M. Le Roy, Franklin voiced the opinion that the crews of leaking ships might often do better by staying aboard their craft than by embarking in small boats only to lose their lives in an effort to reach a distant shore. He maintained that although the entering water might at first gain too rapidly upon the pumps, the point would be reached shortly where the level inside was the same as

that outside. Then the pumps should be able to maintain this level, while casks, chests, and light upper woodwork would help keep the ship afloat, even though awash, until aid might arrive.

Still other ideas in the letter dealt with the paddle wheel. Too much of the power was wasted, thought Franklin, due to the loss of really useful work in the up and the down parts of the stroke. He judged it would be better to propel a boat by picking up a stream of water from under her keel and pumping it out again at her stern.

As a matter of fact, some years later, when experiments with steam engines became common, this plan of Franklin's was given a trial—for example, in the engine designed in 1798 by the celebrated Chancellor Robert R. Livingston, of New York. That particular engine racked its boat to pieces.

THIS same long letter also discussed methods of hauling boats ashore through surf, suggested special forms for the ship's planking, and even included designs for curious "soup dishes" which could be depended upon not to overturn in rolling weather. Water-tight compartments, first invented by the ever-resourceful Chinese, are mentioned and approved. Perhaps most of these things do not represent any vital contribution to the science of seamanship; nevertheless, this letter is an excellent sample of Franklin's ingenuity and of his inexhaustible interest in maritime improvements.

When Franklin again went to London, this time as the accredited representative of Pennsylvania, he was not the humble fellow of his first visit, but a personage. His close friends were such men as Priestley, the discoverer of oxygen, and William Strahan, the rich publisher who was also a friend of Doctor Johnson. In

the five years of his mission he made many experiments, one of which was designed to prove that a ship moves faster in deep than in shallow water.

He built a wooden trough, fitted with a false bottom which made it possible to regulate the depth of water in the trough at will. Attaching a string to a boat model, he carried the other end over a pulley and made it fast to a silver shilling as towing engine. The falling shilling dragged the boat more swiftly when the water was deeper. In this simple way, he established the truth of this great natural law, which seems to have been neglected by all previous works on science.

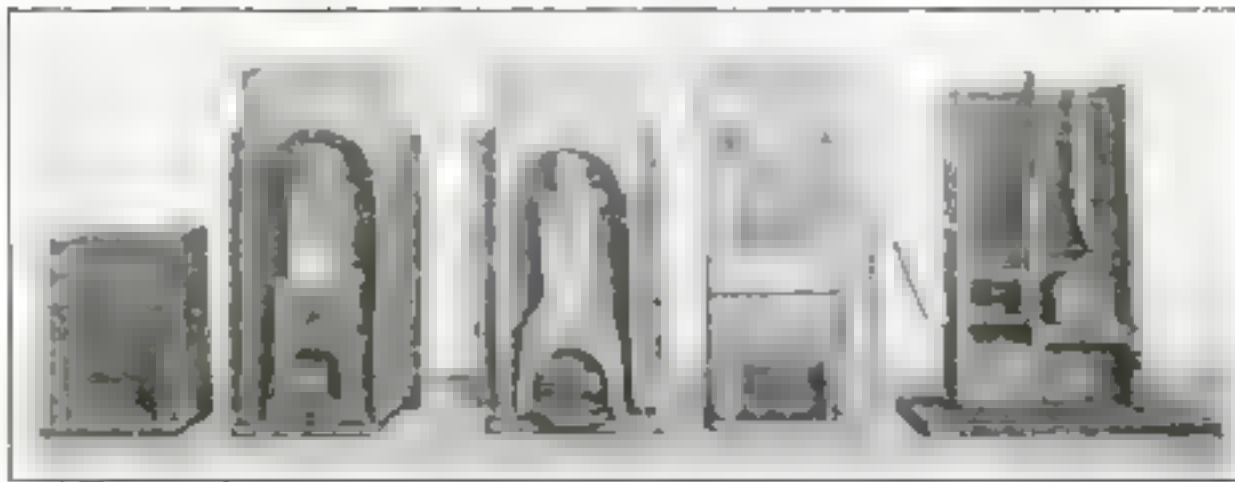
SUCH everyday object lessons, such demonstrations as could readily be duplicated with practically no scientific apparatus by anyone in his own home, gave Franklin the widest appeal. It is safe to say that, in all history, he was "the first great popular scientist." Although, strangely enough, he never wrote a book on science, he could easily have done it, if his many other activities had not consumed so much time.

Take, for example, his study of water-spouts. The first time his eye met one of these, he thrilled to its spectacular beauty just as anyone who ever sees one must thrill. Then there popped into his head the inevitable question, "What causes it?" As usual, his ferret mind, once loosed upon this trail, would not leave it until it had dug out its rat in the form of a satisfactory answer.

He had already thought about whirlwinds ashore, and so he was not long in establishing an analogy "Both whirlwinds and water-spouts," he wrote, "occur most frequently in the daytime, after periods of great heat when the air had been free from winds. Both, in motion, are rotary as well as progressive." Again, he had noticed that, from the space surrounding a whirlwind, the wind blows in toward the whirl from all directions.

ON INQUIRING among his sea captain friends, they told him that they had experienced this same thing with spouts. Finally, if a spout, through its progressive motion, left the sea, it acted exactly like a whirlwind over land. Having made elaborate drawings to illustrate his observations and deductions, Franklin announced his conclusion that the two are identical manifestations, produced under different circumstances. In this, later scientists have supported him.

Franklin's well-trained fingers were always itching to build something. His distaste for the



Types of the Famous Franklin Stove

Because Franklin didn't like smoky rooms—and Colonial homes in winter were veritable smoke boxes—he invented a stove which heated the room evenly and carried smoke away. It was a revolutionary idea, and was adapted to many types of stoves.

smoke-laden rooms of the time finally gave them an opportunity to show what they could do.

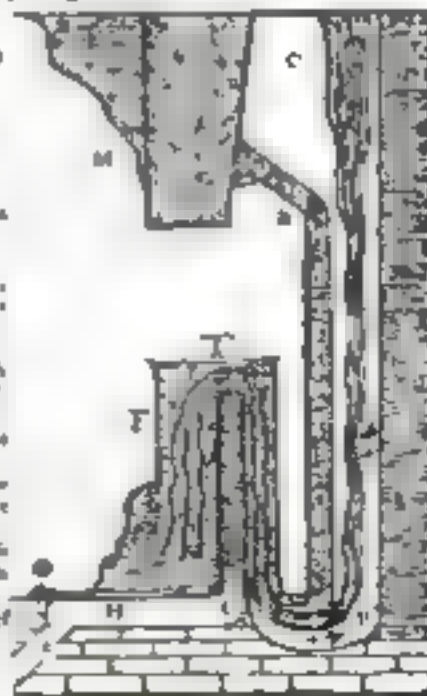
At that time, there was little scientific knowledge of open fireplaces. The "Holland" stoves of the day afforded almost no ventilation, and the "German" type was simply an iron box. Therefore, it remained for Franklin to produce the "Pennsylvania fireplace" or, as it became popularly known, the Franklin stove.

Doubtless he merely applied the same principle he had encountered in his study of storms over areas of changing pressure and rarefied or "thickened" atmosphere. Hot air, of course, must rise, and he constructed his fireplace to obtain from this the best result.

HIS stove included special bottom plates, top plates, side plates, and "two middle plates which, joined together, form a tight box with winding passages for warming air." A false back of brickwork was built into the chimney. Then, as the warm air rose, it was prevented from going up the chimney by this false back. It passed, therefore, into the room and up to the ceiling, its place being taken by fresh, cool air.

PROFILE of the Chimney and FIRE-PLACE.

- M The Mouth-piece or Brack of the Chimney.
- C The Funnel.
- B The false Back or Chimney.
- S True Back of the Chimney.
- T Top of the Fire-place.
- F The Front of it.
- A The Place where the Fire is made.
- D The Air Box.
- E The Hole in the Side-plate, thro' which the warm Air is catching & out of the Air Box into the Room.
- G The Hollow for & with fresh Air, coming at the Pallage I and ascending thro' the Air Box thro' the Air-hole in the Bottom-plate into.
- C The Perforation in the Hollow to keep the Air and Smoke apart.
- F The Pallage under the false Back and Part of the Hearth for the Smoke.
- S S S S S The Canal of the Smoke.



Franklin's Own Sketch of His Stove

A false back was the feature of Franklin's fireplace. The warmed air rose but, prevented from going up the chimney by this back, passed into the room, being replaced by fresh air. Smoke, on the other hand, passed unhindered up the chimney.

Thus the whole room was warmed, with the advantages, as claimed by Franklin, that the temperature was even, with "no cold drafts, so uncomfortable to the back, and a result ideal for invalids. In rooms where much smoking of tobacco is done," he adds, "it is advisable to cut a small hole, five or six inches square, in the stove funnel, which,

when fitted with a movable plate, will carry off the smoke."

History, of course, relates that he refused to take out any patent protection for this invention, although he was strongly advised to do so. He dismissed the advice with a Golden Rule gesture: "Since we profit so largely by the genius dwelling in the minds of others, we should be ready and willing to give them the fruits of our own minds."

IN A sense, this instance of an uncommercial point of view is not wholly consistent with the picture of a frugal Franklin which has come down to us. It cost him something, for it promptly resulted in the copying of his plan by an Englishman who read Franklin a widely published description, built similar "Pennsylvania fireplaces," and made a pretty penny out of them. But Franklin, hearing of this, merely smiled. Ideas, with him, were the easiest and cheapest things in the world to produce.

He always kept up his interest in ventilation and kindred subjects, in which he gained a reputation as an expert. To one seeker for information, he wrote, "If you will but let me have the complete description of your room, its situation and connexion, possibly I may form a better judgment of how to get rid of the objectionable smoke."

VENTILATION suggested interesting ideas in hygiene and medicine. Believing that the human body breathes through its pores, he proposed to give it this opportunity by walking naked about his room with the windows wide open to the night air. He made copious notes upon the inception and treatment of colds. He wrote a series of questions, asking whether this or that would bring about the affliction, and then proceeded to answer them himself. Thus: "By putting a damp shirt on a dry body? Yes. By putting a dry shirt on a wet body? No, though this wet the shirt ten times more." People, he declared, think that they catch colds by coming out of heated rooms into the fresh outdoors, whereas they really get them by being in such places.

Exercise, he declared, would cure a cold, while other remedies (Continued on page 150)

How to See *That* Your Oil Burner Is Properly Installed

You can check up on it yourself if you follow these pointers, laid down by an expert—What service means to you

By P. E. FANSLER

NOT even a perfect oil burner will give you heating comfort in your home unless it is properly installed and unless the dealer from whom you purchased it stands ready at all times to give you prompt and adequate service.

As a home owner, therefore, you are confronted with two equally important problems. You must pick out a good oil burner, and you must make sure that the burner will be properly installed and serviced.

Even in these days of highly perfected automobiles, you would hesitate about buying a car from a dealer located so far away that you could not expect to get service if anything went wrong. The car might not give any trouble at all for a long time; yet you would always have the feeling that even a slight difficulty would be a serious matter just because the dealer wasn't within easy reach.

And the oil burner should be classed with the automobile as far as service is concerned, although the oil burner actually ranks considerably higher from the standpoint of long-continued operation without attention.

That means, of course, that you must investigate the standing of the dealer as well as the reputation of the oil burner he sells. While there are a number of satisfactory makes of oil burners, your choice may be limited to one or two simply because they happen to be the only ones that are adequately represented in your neighborhood. Sales and service stations for all the popular makes of automobiles are now scattered all over the country in almost every village, but, while the oil burner makers are bending every effort to increase their lists of reliable dealers, there are still sections where there are no dealers at all and others where only one make is represented.

Let the salesman explain the merits of the burner he is selling. Get him to go into full details about its operation. He will want to know what kind of a heating plant you have in your home, and before he will quote you a price he undoubtedly will have the company's heating engineer come around and make a survey of the conditions under which the burner will have to operate.

ASK him for a list of customers using his burner in your neighborhood. It will be well worth while to talk with as many of them as possible, getting the opinions of actual users of the burner as

to its efficiency and reliability. Get a line on the number of service calls each home owner has had to make, and the speed with which the service man appeared on the scene.

Find out how long each burner has been in service and, if some of the older burners are in operation at the time you make your call, notice the amount of noise produced as compared with the demonstration burner in the agent's showroom.

Even the Best Burner Will Give Poor Service If Inexpertly Installed



Sloped piping and loose boiler and flue joints may cause an oil smell, and careless electrical work may cost much later. For these reasons, be sure to select a reliable dealer who will make a satisfactory installation as shown above.

Of course the slight rushing noise produced by the burning oil will be the same no matter how old the burner is, but a marked increase in the motor noise would indicate either that the motor was wearing rapidly or that the owner had not lubricated it often enough.

Question each owner on the subject of economy so that, comparing the size of your house with his, you will be able to approximate the probable cost of heating your own home.

In questioning oil burner owners about fuel costs, try to get information that covers at least one whole winter season. It is unfair to compare the consumption of oil during October, for instance, with the average amount of coal burned during each month of the previous year, simply because the consumption of fuel in any home starts low in the fall, rises to a peak during the coldest winter months, and

then falls off again as spring approaches.

Notice, also, the size and location of the fuel tank in each of the installations.

A large tank has the advantage of permitting you to buy your oil in large quantities, lessening the chance of running out of fuel during a long cold snap when the roads are blocked with snow. Companies selling oil usually sign contracts in the spring or summer, guaranteeing the price for a year. Naturally, if you have a 1,000 or a 1,500-gallon tank and can take delivery in "tank wagon lots" of 600 to 1,000 gallons, you can get a better price because it costs less to deliver these "lots" that do not have to be hand-measured.

You may easily save enough by buying in "wagon lots" to save, in three or four years, the excess cost of a large buried tank over a small basement tank.

THE fumes produced by burning oil carry the characteristic oily odor regardless of the type of burner, but this smell cannot get into your house if the boiler and flue joints are absolutely tight.

A slight leak in the flue between the check draft damper and the chimney will not ordinarily allow coal gas to get into your house when you are burning coal, because the natural draft of the chimney causes air to be drawn into the leaky joint of the flue pipe. The mechanical draft type oil burner forces air into the fire chamber without regard to the natural draft. Unless there is a strong natural draft developed in your chimney, the forced draft from the burner may overcome the slight vacuum in the flue and create a low pressure instead. It is this possibility that explains the need for absolutely tight flue pipe connections.

IT WILL be necessary to make sure that your chimney is in perfect shape and that there are no openings through which gases could get into your home. And if the men who make the installation are competent they will examine the inside of the chimney and make sure that it is not clogged up with soot and ashes which have accumulated from the burning of coal.

When properly adjusted, the modern type of oil burner produces a flame that is practically free from smoke or soot, so if you have heard of anyone who has experienced trouble with soot clogging up the chimney, you can be sure that the oil burner was set for too rich a mixture. In other words, the air supply was too

limited for the amount of oil that was being fed into the combustion chamber. Everyone who has had occasion to regulate the wick on a kerosene lamp or stove knows that, if you turn the wick up too far, smoke will be produced. A lamp operating with the wick too high exactly parallels the case of an oil burner that is feeding too rich a mixture.

The only other possible chance for oil smell is from the actual leakage of oil fuel out of the piping or the burner. The manufacturers take great pains to make the joints in the burner absolutely oil tight, but trouble may occur if the pipe installation is done carelessly or with poor tools. Piping done in a slipshod fashion may hold oil for some time, but is sure to spring a leak sooner or later.

AS FOR the electric wiring, a good workman will solder and tape the connections so that no trouble can develop from this source. The thermostat is part of the electric control circuit, and while its installation consists merely of screwing it to the wall and running wires from it to the control box near the oil burner, the location of the thermostat is vitally important.

The arrangement of the room will determine the best position for the thermostat. Because it must be made sensitive to slight changes in temperature in order to respond with great promptness to variations in the room, it should not be hung where the opening of a door or window will blow cold air directly on it. The result of installing the instrument in such a location would be the frequent starting up of the oil burner unnecessarily.

Usually the best place for the thermostat is in the living room as far from the doors and windows as possible. In other homes the temperature may be more uniform in the dining room. Avoid drafty halls and stair landings.

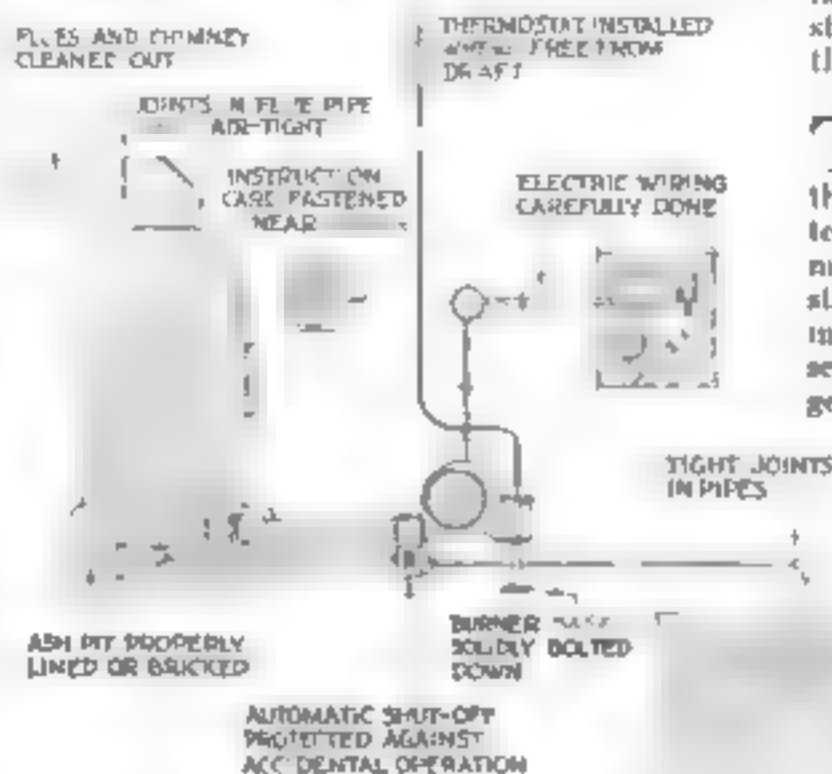
Too much noise and vibration occasionally are the result of defective support for the moving parts of the burner. The base on which the blower and motor are mounted should be of solid construction, and the frame of the burner should be bolted tightly on the base.

All types of mechanical draft oil burners are fitted with automatic shut-off devices so that the burner will be stopped and the oil supply shut off if anything goes wrong. These devices should be protected to prevent accidental shut-offs if someone unwittingly brushes against the apparatus. Many calls for the service man have been caused by the tripping of the automatic shut-off by a pet dog or cat.

INSTRUCTION cards showing how to start up the burner in the fall and the precautions to be observed when turning it off in the spring, with other necessary details about the care of the apparatus and the oiling of the motor, are supplied by the manufacturer. This card should be permanently fastened to the wall near the oil burner.

A high grade oil burner correctly in-

stalled will insure you heating comfort only when it is backed up by the right kind of service. It is quite true that there are records of oil burners that have operated perfectly for three years or more without any attention from the service man. At the same time it must be remembered that breakdowns are possible



Ten Points in a Good Installation

If you check up on these ten points when your oil burner is installed, you may be saving yourself considerable trouble, annoyance and expense later.

with any piece of machinery, no matter how perfectly built.

Something may go wrong during a cold snap, when the thermometer is hovering around the zero mark. Getting the burner going again with the least possible delay is imperative at such a time, and service must be obtainable at once.

Reliable oil burner manufacturers and dealers recognize the need for good service, and make a point of having expert service men available at all times. They also keep a complete stock of spare parts on hand. As a general rule, the reputable oil burner dealer does not attempt to sell or install oil burners in homes located so far from the service station that there will be a doubt about the possibility of quick service.

THE distance between the service station and the oil burner installation that is permissible depends to a large extent on local conditions and the equipment of the service station. If, for instance, the roads are almost impassable in winter, then it is obvious that the service man is going to have a hard time getting to your house if you are located thirty or forty miles away.

Stressing the importance of good service should not by any means convey the impression that oil burners are balky, unreliable pieces of apparatus that require constant attention. That is certainly not true. Mechanical draft oil burners of approved types are just as reliable as the finest kinds of automatic machinery in other lines, but the need for prompt service in the case of the oil burner is emphasized by the important work it performs in giving you continuous heating comfort.

And the records of the oil burner service stations show that a great many calls for service are unnecessary. The most frequent call of this type comes from the woman who suddenly discovers that her house is getting cold because the oil burner is not operating. Without making any investigation at all, she phones for the service man, and the latter rushes around to the house on the double-quick only to find that the oil supply tank is empty.

ANOTHER call is from the home where a fuse has blown in the electric supply line. Troubles like this obviously cannot be blamed on the oil burner, but they do call attention to the fact that the owner of a heating plant operating on liquid fuel will find it worth while to familiarize himself with the more important features of his equipment.

Most dealers in oil burners make sales with the definite understanding that service of all kinds is to be without charge for a certain length of time. But no oil burner is sold without a time limit on the free service agreement, and after that period expires you will be expected to pay a service charge for each visit of the repair man. If a fuse blows out and you call the service man around to fix it, you will have to pay a fixed charge amounting to two or three dollars just to replace a fuse that may not cost more than ten cents. During the period when service is free, you should do your best to become familiar with the simpler troubles that may come up, so that when the free service period expires you will be prepared to take care of all simple matters yourself.

Help in Selecting Your Burner

THE engineers of the Popular Science Institute of Standards are ready to help you solve your oil burner problems.

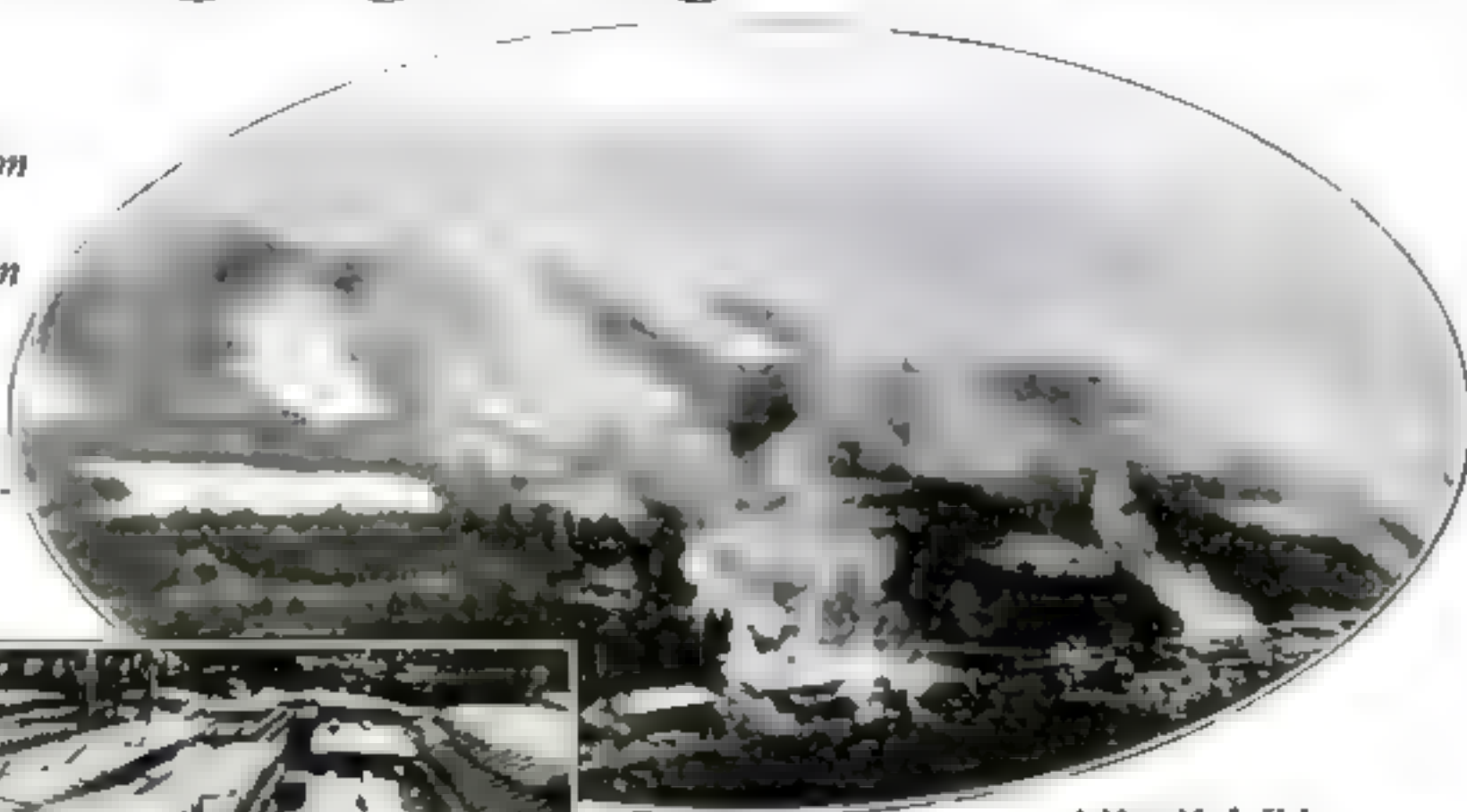
The Institute has undertaken, in conjunction with *The Heating and Ventilating Magazine*, a nationwide survey to determine the efficiency of the several oil burners.

This survey is the most elaborate of its kind ever made. Oil burners in homes in every part of the United States are being inspected and detailed reports are being compiled on the results of the various types.

For information about oil-burning equipment for your home, write to Popular Science Institute of Standards, 250 Fourth Avenue, New York City. A chart has just been prepared that will assist you in solving your problem. Ask for it!

Warding *Lightning* from Arsenals

Can Munition Depots Be Protected from Death-Dealing Bolts?—Recent Blast Starts Controversy



A Man-Made Volcano Breaks Loose

It took a lightning bolt to start this conflagration. Government arsenals are rigidly safeguarded against fire, but lightning arresters proved powerless to prevent the Lake Denmark disaster, pictured above. Can such blasts be prevented? Below: Wreckage of the power plant. Left: Stored shells

EXPERTS had taken every humanly possible precaution, so they thought, to safeguard the twenty-one Government munition depots where our Army and Navy store some two billion dollars' worth of explosives. And then, without warning, at the height of a storm one afternoon recently, the clouds let loose a livid lightning bolt and hurled it upon the great munition station at Lake Denmark, New Jersey. One bolt snuffed out more than a score of lives and destroyed more than \$80,000,000 worth of property.

The unforeseen and unexpected had happened.

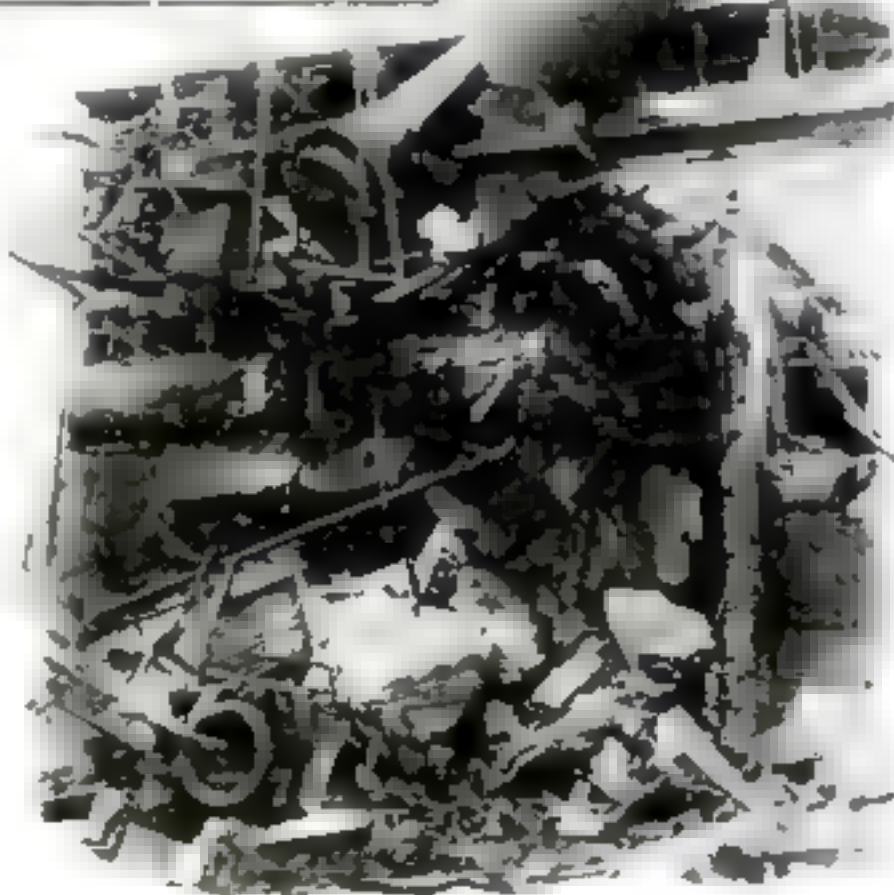
Naval authorities, in the face of criticism, reminded the public that it was the first disaster of the kind in our history and that every available means known to science had been employed to minimize the danger of such a tragedy.

Some experts asserted there was no sure way of preventing the danger from lightning.

And still there persists the question: How can a repetition of the Lake Denmark disaster be prevented in the future?

Among scientists who insist there is a practical way to assure absolute protection against lightning is Professor Michael I. Pupin, of Columbia University, one of the world's foremost electrical experts.

The scientific lightning protector urged



by Professor Pupin consists of the use of grounded copper sheeting for roofs and walls.

"Suppose," he says, "you have a house and want it protected from lightning. Put on a copper roof, protect the chimneys with copper sheeting, and then connect the roof at numerous points by copper rods with the ground. The rods must go deep into the ground until you strike wet soil. Cover the sides of the house with copper sheeting or other metal, which must also be connected with the wet ground. This will keep out lightning.

"All structures where explosives are kept should be constructed in that way."

Professor Pupin also points to the fact that the Woolworth building and the Park Row building in New York City, the highest buildings in their vicinity, never have been struck by lightning, while other buildings near them have been struck often. The roofs of these two buildings are covered with copper, conductively connected to the steel girders of the buildings and to the ground.

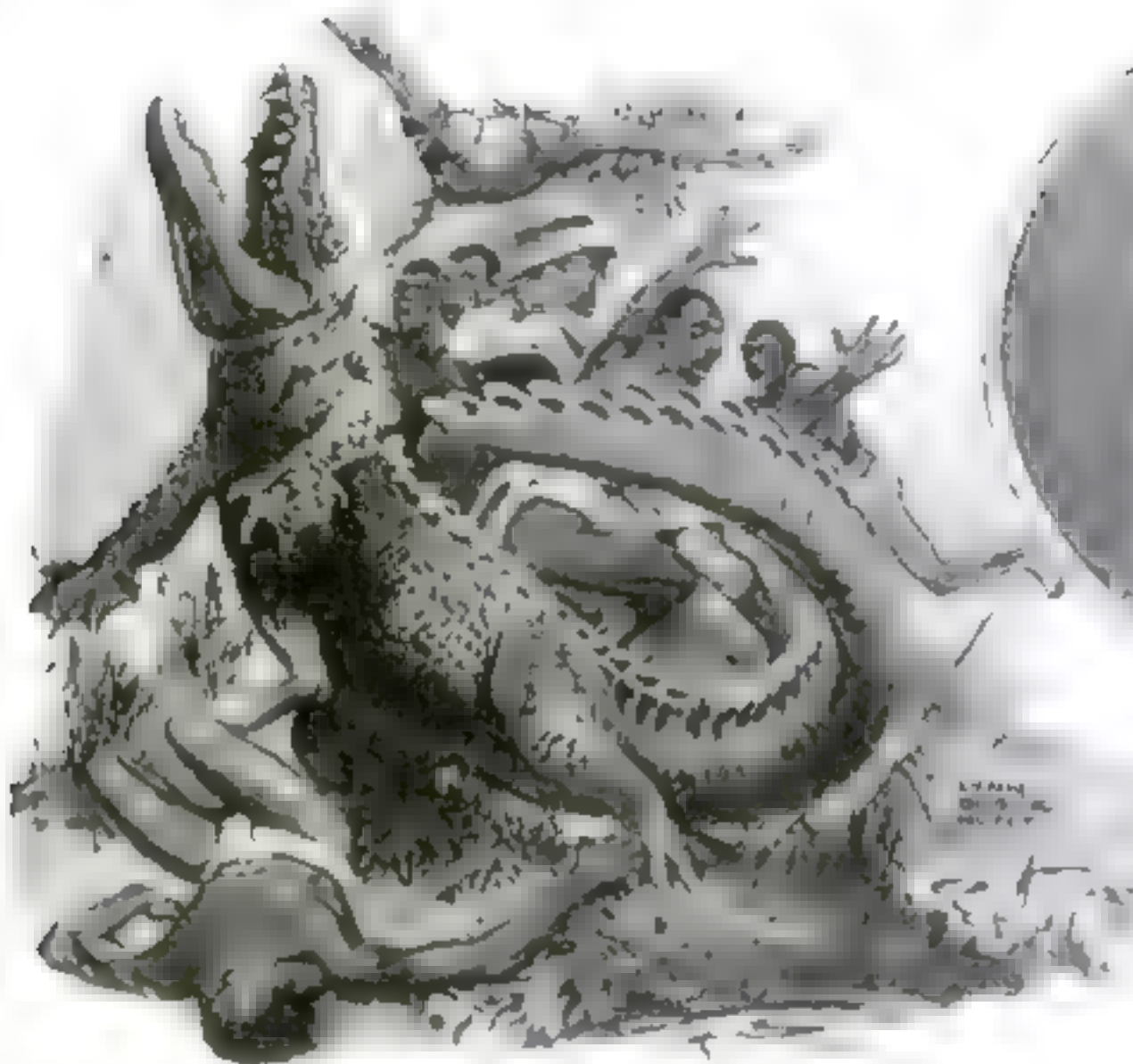
"BUILDINGS for the storage of explosives should be of steel," says Professor Pupin, "and all windows and door openings copper-screened."

In general, the Government's method of constructing storage magazines has depended on the type of ammunition to be stored. For TNT and other

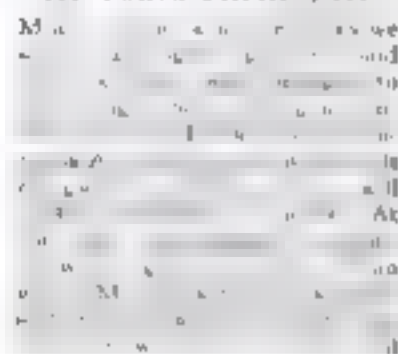
high explosives, which are more subject to fire than to concussion, the buildings have been made fireproof with walls of hollow tile and gypsum slab roofing. Such explosives as black powder, dynamite, tetryl and dry picric acid, in which the danger of detonation is great, are stored behind bullet-proof tile walls filled with sand, with gypsum and slab roofings.

To guard against fire, the magazines are spaced three hundred feet apart, and all underbrush is cleared away. The protection against lightning thus far has consisted of lightning arresters,

My Life Wasn't Worth a Dime—



He Taken Them Alive



When a Giant Chimpanzee Crushed Me in a Death Hug, or When a Huge Crocodile Flung His Tail at Me—Some Other Strange Adventures in the Jungle

By J. L. BUCK

A MONSTROUS black chimpanzee, rearing fully five feet high out of the tall saw grass; a great beast that had never looked on man before—white or black. That was what I saw, in the second I faced him, there at Cape Mount in the Vey Country of West Africa, and I realized, too, that he was the largest "baboo" I had ever seen.

He was balanced on his rear legs, his great jaws parted in what looked to me like a terrible grin. Then he lifted his arms—powerful as steam shovels—and coming at me, flailed the thick grass as he came, crying out hoarsely "hoo—hoo!"

To shoot at such close range was useless. I saw the yellow of his eyes, and one sentence beat across my mind—"Sally Buck," was the sentence, "Sally Buck, my wife, you'll be a widow tonight!"

The next instant we had grappled. We went rolling downhill, while the grisly thought pounded over and over in my brain. In a moment more his great arms would be crushing me against his ribs.

And then—

I saw a net snap about his sprawling limbs. A second more, and he had rolled

himself into it, a ten-yard chimpanzee net one of my faithful boys had thrown.

But his hold was yet on my ankle. I saw him struggle to break through the tough liana net, my foot still in his grip. I watched one of his mighty arms break out of the net. That monstrous embrace—I tried to get to my feet, when between us, breaking the chimpanzee's hold on me, darted a black boy, mad with terror, pursued by a half-grown chimpanzee. He trod on the feet of the old male, and from my captor was torn a howl of rage, of devastated dignity. He released his hold and I fell back, unconscious.

"SALLY BUCK," I whispered, as I came to, "Sally Buck, my wife, you've got a chance—tonight—of not becoming a widow." I had awakened to find—but let me tell first about the beginning of that chimpanzee hunt.

I'd gone up to Cape Mount, in West Africa, after an especially rare and healthy species of chimpanzee said to inhabit that trackless mountain. The morning of the sixth day, as my twenty boys and I wound down a lean ravine between two steep

hills, we heard a savage baying aloud of us, to the left. It was a great male chimpanzee. It allowed, motioning the boys to have the nets all ready to throw.

I had hardly spoken when a second howl of another big male sounded from the opposite hill, which helped shut in our sloping ravine. Then the signaling started. First one of "fellow" howls, and then the other. They were either comparing notes as to us, the intruders, or they were harrying scolding insults at each other. Anyway, they were mighty angry. But I wasn't alarmed, since my boys were well-trained and my elephant gun was in my hand.

Meantime, they had decided to play hide and seek with us. They kept traveling ahead, hidden by the tall grass, roaring and advancing as we followed, but always keeping hidden. I knew, of course, they were on all fours, as this is the way they travel. I was in the lead. At my heels were my carriers, one boy with a Winchester, others with nets all ready to throw. The boys shouted encouragement to each other. The two big male chimpanzees roared incessantly, and behind, adding to the bedlam, came the village witch doctor, beating on his native drums. Then, out of the turmoil, just twenty feet ahead, the big fellow stood up on his hind legs and made for me!

I'VE already told how we rolled to the bottom of the gully, and how the fear-crazed boy shot between us, surprising the old hairy fellow into letting go his grip on me. Just as I fainted, I tried to shout, "Left! Left, me boy, left!" which in African pidgin means "stop—

let go—don't run, don't show you are afraid!" To show fear with a chimpanzee, or with any wild animal, is certain death.

In the moment that I passed out, the great male broke through the net. Nine times out of ten that would have been the last of me. A few cruel jabs of his powerful rear paws would have been my finish. But the boy and the other chimpanzee diverted the old fellow, and he ran like a shot after the pair, as my servant, Momadu, told me afterward. Down the ravine the entire hunt tumbled, apes and boys. When I came to, I got up and hobbled after them. Ten minutes of traveling told me the story.

That younger chimpanzee had chased the frightened black boy right over the precipice to his death!

It is such adventures as this that have caused the neighbors' children in my home town of Camden, New Jersey, to nickname me "Wild Animal Man Buck." There are thrills a-plenty in the job of wild animal hunting. And there's more satisfaction too, in taking an animal alive than shooting him down before he has a sporting chance to display the ingenuity that's in him.

OF all the animals I catch alive to bring home and sell to American zoological gardens and circuses, the great apes have fascinated me more than any others. Of these, the chimpanzee comes first. There's something so human about these remote cousins of man.

We catch them in traps, with huge nets thrown out to tangle them, in a straight, hand to hand raid—though these are extremely dangerous and with a particular kind of snare trap I myself devised last year.

This is an adaptation of a similar trap American hunters use for taking alive large wild animals. It is set open by a door that falls down when a spring is released. The inquisitive chimpanzee—and these apes are more curious than any old woman you ever saw—sniffs about the trap and spies the fine bunch of ba-

nanas tied inside to the rope that controls the spring. Old ones may sometimes hesitate, but curiosity and greed finally will persuade almost any chimpanzee to step inside. One bite at the fruit and down goes the door. Then our task is to persuade a very indignant ape—who plainly knows a trick has been played upon him—out of the trap and into a cage that is carried by the men hundreds of miles to port and the ship home.

I USE the raid when I have sure knowledge a band of chimpanzees will be at a certain spot at a certain time. My boys and I hide in trees, behind trees, and under cover of rocks or mounds. Sometimes we all arise at a signal and fall upon the apes with bare hands, while they are eating. Sometimes we wait until night, and shake the sleeping animals from trees into nets. The method depends on the number of boys at your disposal and the size and ferocity of the species of chimpanzee you are hunting.

I am constantly amazed, old animal man that I am, by the astounding likeness of these animals to men. I have handled hundreds of chimpanzees, and each has had a different nature, and for each I could find some counterpart among my human acquaintances.

I've handled chimpanzees who were born tricksters; I've had females who were born coquettes; I've had them so clever I could teach them to eat with spoon and knife and fork in a few days. Again, I've sometimes come across an ape so stupid that I could never teach him even the use of a spoon. These boasts

differ in temperament as widely as do men.

I could write volumes about my experiences with chimpanzees, but probably my readers would prefer to hear about a big, handsome rock python that well-nigh equaled the male chimpanzee in providing me with a cold thrill.

We'd come upon a great rock python in the Vey Country. My boy, Momadu, speed him down a large, wide crevasse. The best way to catch a rock python is to drop a live goat down into his retreat. He'll eat it and then lie torpid for hours. In this torpid state, there's not much more work taking him than just to catch hold and carry him off. But we couldn't do this here, since there was no village to buy a goat. Had we killed a wild antelope he would probably have rejected it, since snakes prefer to kill their own meat. I decided to build a runway along which we could prod him into the opened end of a cage.

THE runway built, Momadu got into the hole and started pushing the python toward the cage. But no sooner did the python feel the gentle jab of Momadu's slave than he started to rear up. He was twenty feet long, about 400 pounds heavy. He flopped and hissed and pounded against the runway. Momadu whistled through his teeth to bewilder the snake. I yelled down directions. For a few stubborn feet the hissing snake gave ground. Then something went wrong. A swift flapping, a whirl of dry dirt—the frantic cry of the boy in the hole.

I leaped to the edge. The python had broken through the roof of the runway and was facing me, coiled, primed to strike and constrict! His dull, meaningless little eyes were set for me! A great dry heat broke over me, then a weak dampness. The boy's howled, I wanted to move, but I couldn't budge. Some sort of hunters' paralysis I had after. Fear about had seized me.

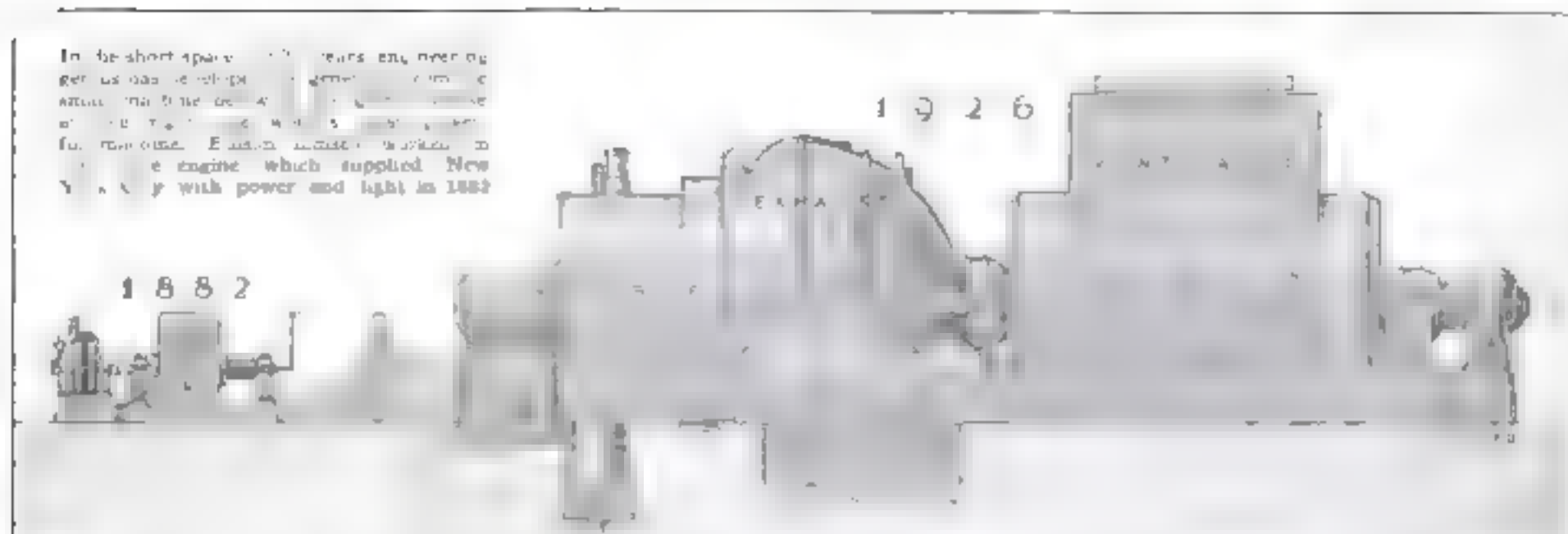
He was coming toward me, hissing as he came. And then, as he spun through the air, a machete, (Continued on Page 30)



"No Man Can Ever Tire of Wild Animals"

Of all the animals Buck captures and brings to our zoos, the apes fascinate him most. Some are so clever he can teach them to eat with spoons and knives and forks in a few days. Others are too stupid to learn even the use of the spoon. He catches them with traps and nets. Right Buck and his helpers equipped for a monkey trapping expedition. Above: The wild animal man's home while in the African jungle.





The Mightiest Machine on Earth

*Power to Run Thirty Panama Canals
Generated from One Unit*

GIANT cranes are now swarming to place the last parts of what will be the most powerful single dynamo in the world. For two years engineers of the General Electric Company have been working on a great dynamo which is to be part of the equipment of the new East river light and power station of the Edison Company in New York City. It is the first of its kind, and which will make this station the largest in the world, capable of producing more than a million horsepower.

Fifty feet high, this single dynamo weighs more than a million pounds. Such is its tremendous weight and size that it had to be shipped in parts, which are now being assembled by the use of special machinery.

In comparison with this single dynamo, other machines, giants of their kind, are dwarfed. Visitors to Panama may have seen and marveled at three mammoth Diesel engines, 1,000 horsepower each, capable of operating the Canal in case of any failure in the hydroelectric plant. The turbine generator in the New York City station could replace ninety-four of these engines; this single machine, therefore, could operate about thirty Panama Canals.

Again, pulling the Twentieth Century express train out of New York on its run to Chicago requires one of the most powerful electric locomotives in the world, with horsepower of nearly 2,000. The generator which bears the title of the world's most powerful machine is capable of generating 84,000 horsepower. It could pull forty-seven loaded Twentieth Century trains!

If, instead of running trains, its power

were used on an ocean liner, it could drive one the size of the *Lerrathian*, with power left over to run three trains. In excavation work it would be the equivalent of thousands of workmen. It could operate 2,000 steam shovels.

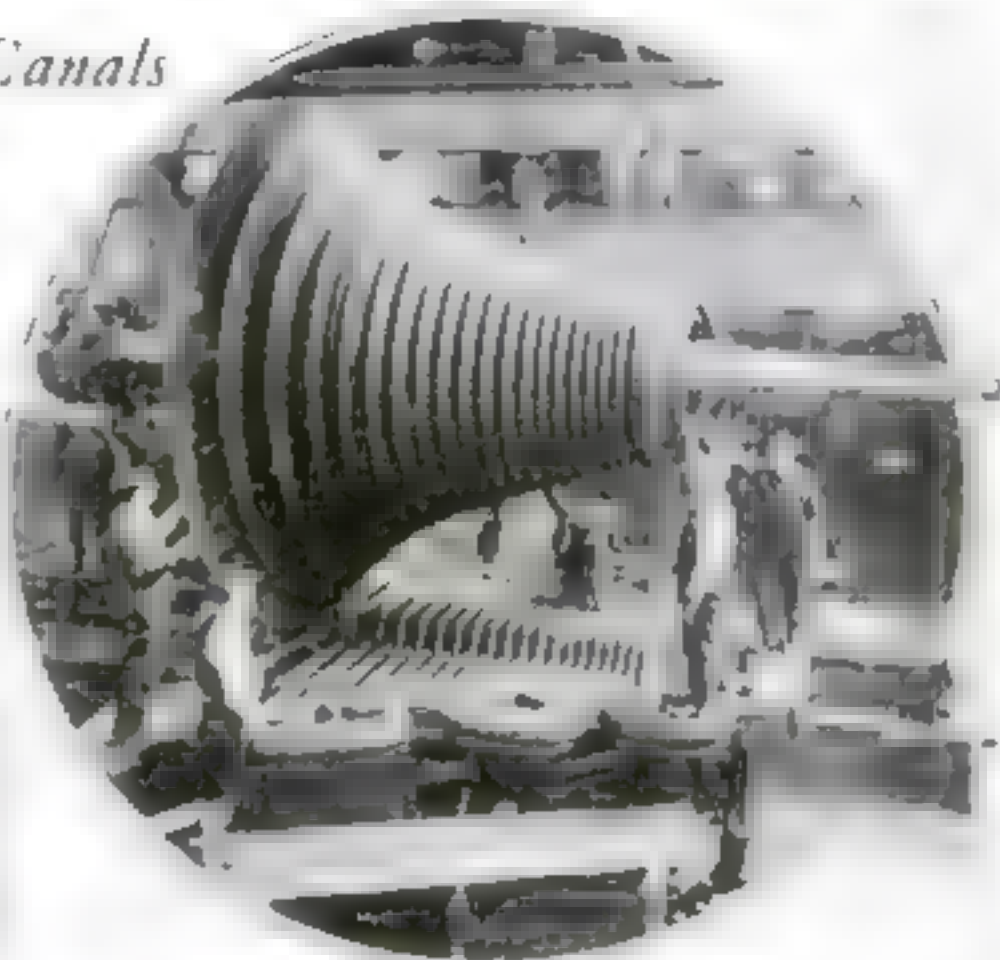
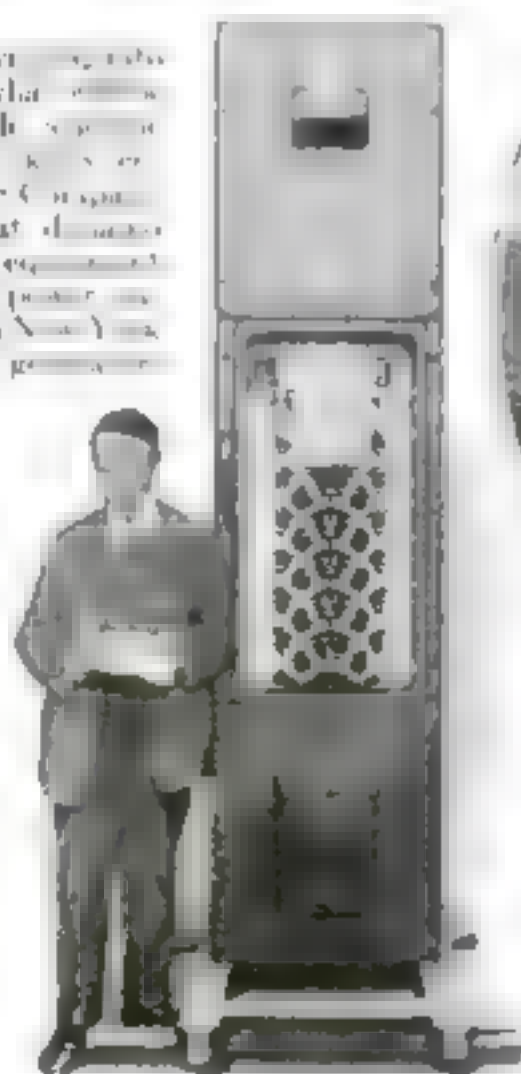
FINALLY—if you can conceive it—seven cities, of 72,000 population each, could have White Ways and be supplied with electricity for every need by this single powerful unit.

The thousands of blades in its giant rotor are driven by steam. To generate the tremendous quantities needed, six big truck loads of coal, each of five tons, must be burned every hour. Built on the river bank, by the use of ingenious travel-

ing coal-handling towers, the station will unload coal directly from ocean-going vessels. Four hundred tons an hour will be loaded without moving the ship after docking, and a new way of loading is being devised for other boats. This was planned so that the new station would not add to traffic congestion in New York City.

Water to be generated into steam will be borrowed from the East river, passed through huge cast-iron pipes to the station, and a minute later poured back into the river. When the station is completed and in full operation, more water will flow through these pipes each day than is brought down from the Catskill aqueduct to New York City. Eight hundred thousand gallons will be pumped every minute.

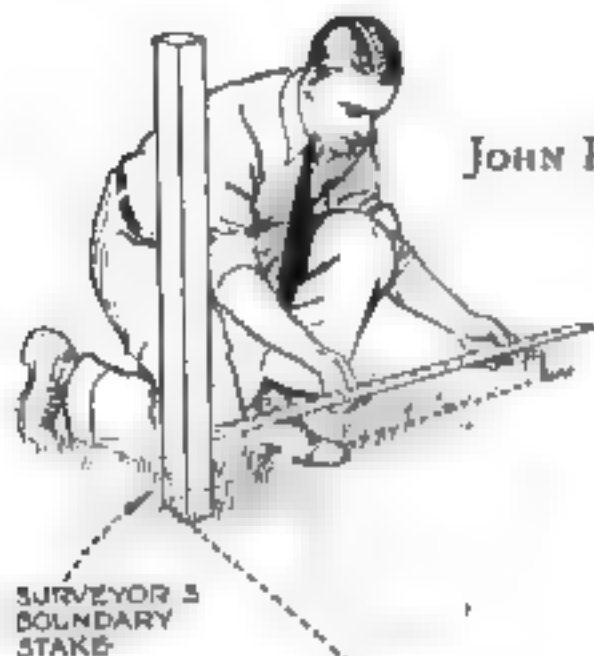
The city which is to have the world's greatest steam turbine was also the first in the United States to use a turbine of any type run by steam to generate electricity. This crude machine was brought from Sweden in the nineties, and generated only about 100 horsepower.



Mistakes to Avoid in Placing Your House on Its Site

Don't encroach on your neighbors or on the street, or build too near trees—Tips on grading, drainage, foundations and water-tight cellars

By
JOHN R. McMAHON



How to Mark Your Boundary Line

From the surveyor's stake, measure off two feet in two directions. Mark these points on new stakes. Remove the first stake and locate your post.

"WHY in blazes," writes a reader, "didn't you start Rob and Ellen right at the beginning of their home building? I mean, telling them first about locating their house on the lot, grading, making foundations and such-like. A nice young couple like that ought to be told."

Hold on, friend reader. As a matter of fact I had a preliminary talk with that nice young couple on those very topics, but the report of our confab was postponed for various reasons. I'll give it now. It isn't too late in the season to benefit other home makers.

"Spacing a house on a lot is important, eh?" was the way Rob began it.

"I'll say it is," was my reply. "People spend wads of cash to overcome avoidable mistakes in this matter. But before we consider locating the house, we should take a squint at the question of survey."

"That's all done for us, isn't it?" asked Ellen. "I hope you don't expect Rob and me to become surveyors."

"No, but you need to understand some things, and it would do no harm for you to check up your boundaries with a tape-line. It is well to know that a stream given as a boundary is never an exact line, so don't build very near it if you want to avoid dispute with a neighbor. An old fence, especially stone, is a pretty dependable line. The old-time compass surveys are likely to be off, due to local conditions and the shift of the magnetic north pole. The up-to-date surveyor does not use a compass but merely a transit, getting his lines by angles which he bases on fixed points."

"But we get a map or blueprint of our lot, don't we?" inquired Rob.

"Yes, if you buy from a realty company; otherwise, probably not. If no map is supplied, you can perhaps fix up

one from the official map kept by the county register of deeds. Just make a copy with pencil on tracing paper. In fact, every home owner should look up the public records for himself and verify his documents. You can get your neighbors' lines and holdings as well as your own."

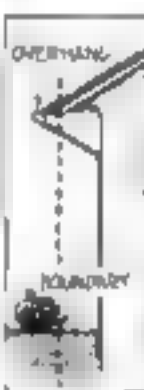
"How about a guaranteed title?" asked the young man.

"So much the better when it's supplied by a responsible title company. The seller does not always give it because of the expense. Without a guarantee, you need a search of title done by a careful lawyer, and generally the buyer stands the cost. Now the map, whether done by a title company or an ordinary surveyor, shows all the boundaries in feet and hundredths—as 88.30, which means 88 $\frac{3}{4}$ feet on that line. Don't bother with the

angle figures also given, which are marked in degrees and minutes, as—"I sketched for them. N. 26° 41' E. "The map is done according to scale, so that with a foot rule you can figure out on it anything you want."

"It must be rather difficult to match up the lot and the map," suggested Ellen.

"Just look for the surveyor's stakes at the corners," I replied. "Usually these are plain wood with a small nail driven in the top marking the exact point. I'll tell Rob how to replace a stake with a

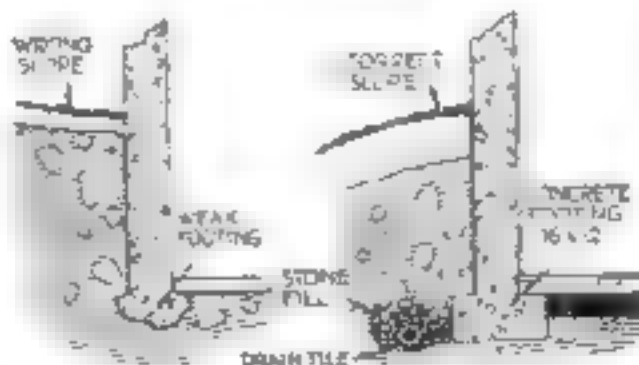


If you build too near the boundary line, your roof may project over your neighbor's land—a serious encroachment. Trees planted too near the house will block off air and light.

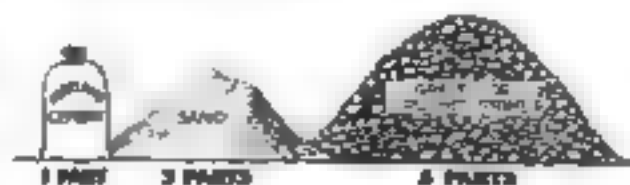


Are You Planning to Build?

MR. McMAHON'S services are available to assist our readers in solving their building problems. If you are thinking of building a home write to him. He will be glad to answer free of charge letters addressed to him care of POPULAR SCIENCE MONTHLY 250 Fourth Avenue, New York City.



For a strong foundation, have a concrete footing sixteen inches wide and a foot deep.

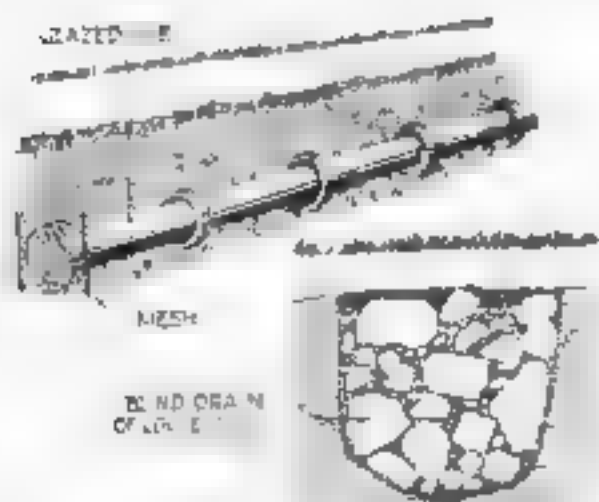


One part cement, three parts sand and five parts of gravel or crushed stone is best for the foundation. Be masterly with the compass.

permanent concrete marker or a fence post. Measure off two feet from the nailhead in two directions at angles; mark these points with nailheads on new stakes. Now remove the surveyor's stake and locate the post or marker with a two-foot rule. Get the bottom of a post right, use a level to make it vertical. Of course you allow for post thickness. When the corner posts are up, stretch wires between them to obtain the boundary or to line-up intermediate posts for a fence."

"Suppose I don't want a fence," said Rob, "or if I do, how about the neighbors joining in on the cost?"

"In many states boundary fences are put up jointly by neighbors under legal regulation. The law may even require your neighbor to contribute his share of fence and its upkeep. By the same token your neighbor may compel you to cooperate on a fence. It is better to keep law in the background and get along by friendly agreement. I would mark a boundary somehow, by a hedge if not a fence. It prevents trespassing and trouble. A fence has legal value; it cannot be removed without mutual consent or certain proceedings. It is good



Drainage lines or blind ditches keep ground near the foundation from getting water soaked. Note the mesh at the pipe opening.

insurance for your property. The law usually specifies height and other details required for a boundary fence."

"How about our line on a street or highway?" pursued the young husband.

"The main point is not to crowd the public domain. Don't think your lot extends to the very edge of a narrow public road, which is probably built only half as wide as it should be. Find out the official width, including sidewalk, to avoid encroachment and future trouble. In the last few years several million dollars' worth of front steps that encroached on streets have been shaved off houses in American cities. In the suburbs the greedy owner stands to lose some of his front lawn if not his steps."

"What is the meaning of 'restricted property'?" asked Ellen.

"Usually that cheap houses cannot be built on a development and no factories or stores are allowed. A house must cost at least ten thousand dollars, let us say. There may be also a requirement of locating the building on its lot so that all the houses in a street will stand on a uniform line. We are talking of private development restrictions."

"Some towns and cities have zoning ordinances which restrict the layout of homes. They may tell you how far you can build from the street, side lines and back line. Such regulations are mostly based on fire safety principles."

BUT couldn't we leave it to our building contractor to find out the rules and place the house right?" inquired Rob.

"Not by several jugfuls. I just heard of a case where the contractor, in the absence of the trustful owner, put up a house smack on the road, because the owner had said he wanted plenty of garden space behind. The architect, if you have one, certainly should have some say on location. If the ground is irregular, he will adapt his plan to suit and pick out the best site. Keep well away from the road for the sake of quiet and cleanliness."

"On the other hand, too far from the road means high cost of putting in water, gas, electricity and sewer connections.

Any house within sixty feet of the road can have an electric line direct, without expense for a private pole and its upkeep. You can stand a pole or two to get farther back. But a water line at one to two dollars a running foot, added to other conveniences, soon runs into money."

"Is one lot big enough for our house?" was Ellen's query.

"Hardly, if it is a city lot twenty-five feet wide by one hundred feet deep. The width is the trouble. The house put in the center would have mighty little room left at the sides. If put on one side line, there would be barely room on the other side for the family car to enter its garage. I would advise two lots or at least a width of fifty feet. That is crowded enough for anybody."

"Apart from the question of sunlight, air and privacy, it isn't safe to build on or near a boundary. Your roof may project over your neighbor's property. The line may be wrong by several feet, owing to somebody's mistake. You then have to buy a strip of your neighbor's land at a good round price or move your house."

"You've got me aroused to the encroachment peril for fair," announced Rob. "I'll build plumb in the center of the biggest lot I can buy on the so-little down plan."

FINE! Now that you've digested one peril, I'll tell you another. Many people misplace their houses without infringing on boundaries. They build too far forward or back, down in a hole or too close to a patch of woods. Be sure that your site is right from every standpoint.

"You say not to build too near a patch of woods," remarked Ellen. "I always like houses that tangle into trees."

"They look nice," I admitted, "but are not so good to live in. Trees cut off sunlight and air. Their storm-broken branches may damage the house, not to mention telephone and power wires. The falling leaves pile on the roof and clog the eaves troughs, while the roots of the trees creep into drains, lifting sidewalks and even splitting foundations. Plant shrubs or dwarf trees near the house and keep the big fellows away. If you want to keep a big tree that is too close, prune it down gradually during several winters until it becomes the proper size."

"Your speaking of draintiles reminds me to ask about the drainage and grading question," said Rob.

"And that's often a serious problem. So much so that in some cases the house location might be determined according

to natural drainage conditions. It costs money to fight with and divert a lot of water that has a habit of exorting down a slope or gush. The dry season means nothing. Find out how the water behaves in spring, fall and winter. It is best, if you can do it, to divert water a good way from the house by grading, that is, making a gradual slope away from the dwelling. Plant grass seed over the slope to make a good lawn. This protects as well as prettifies. It will carry away plenty of water without soil-washing or other harm. Making the water travel far enough from the house keeps the ground near your foundations from getting soaked and making trouble in the cellar."

"I guess a few draintiles help out too," observed Rob.

"Yes, they may be needed in addition. Putting a tile line under a grass slope or shallow sodded ditch makes a



Let the terrace slope be gentle enough so that you can use a lawn mower on it. On the steep slopes, shrubs will hold the soil.

choice combination. Water is thus carried away both above and under the ground. How deep should the tile be laid? Usually a foot and a half to the top of the tile. You can partly fill above with cinders. I would use a six-inch tile for small jobs, always the glazed bell-jointed kind, which do not crack like the unglazed farm tile.

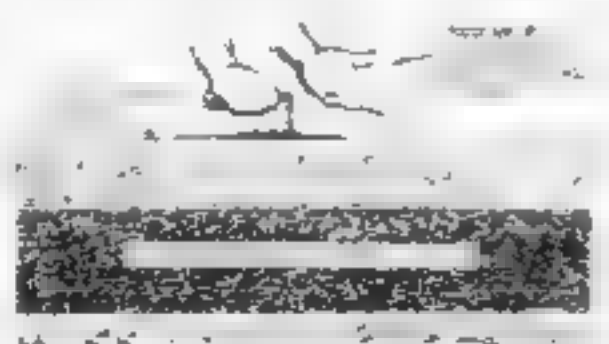
"Instead of tile you can make a so-called blind ditch of loose stones in a trench, covering with a little hay before you fill in with earth. Protect the entrance to your underground drains with two-inch mesh wire."

HOW about open ditches lined with stone, such as they have along highways?" asked Rob.

"They're costly in labor, likely to clog because of uneven surface, and are hard to keep free of weeds and grass. Frost heaves the stones whether they are cemented or not."

"Suppose our home site needs a terrace and a retaining wall," suggested the young man.

"They are all right if properly built. A terrace is usually an earth embankment with a sod surface. It should be not too steep, with a good layer of top soil so that grass will grow on it. Make a slope that you can run a lawn mower on. If the soil is shifty or the weather unfavorable for



This is a good method of laying a concrete cellar floor over a bed of six inches of hard cinders.

(Continued on page 157)

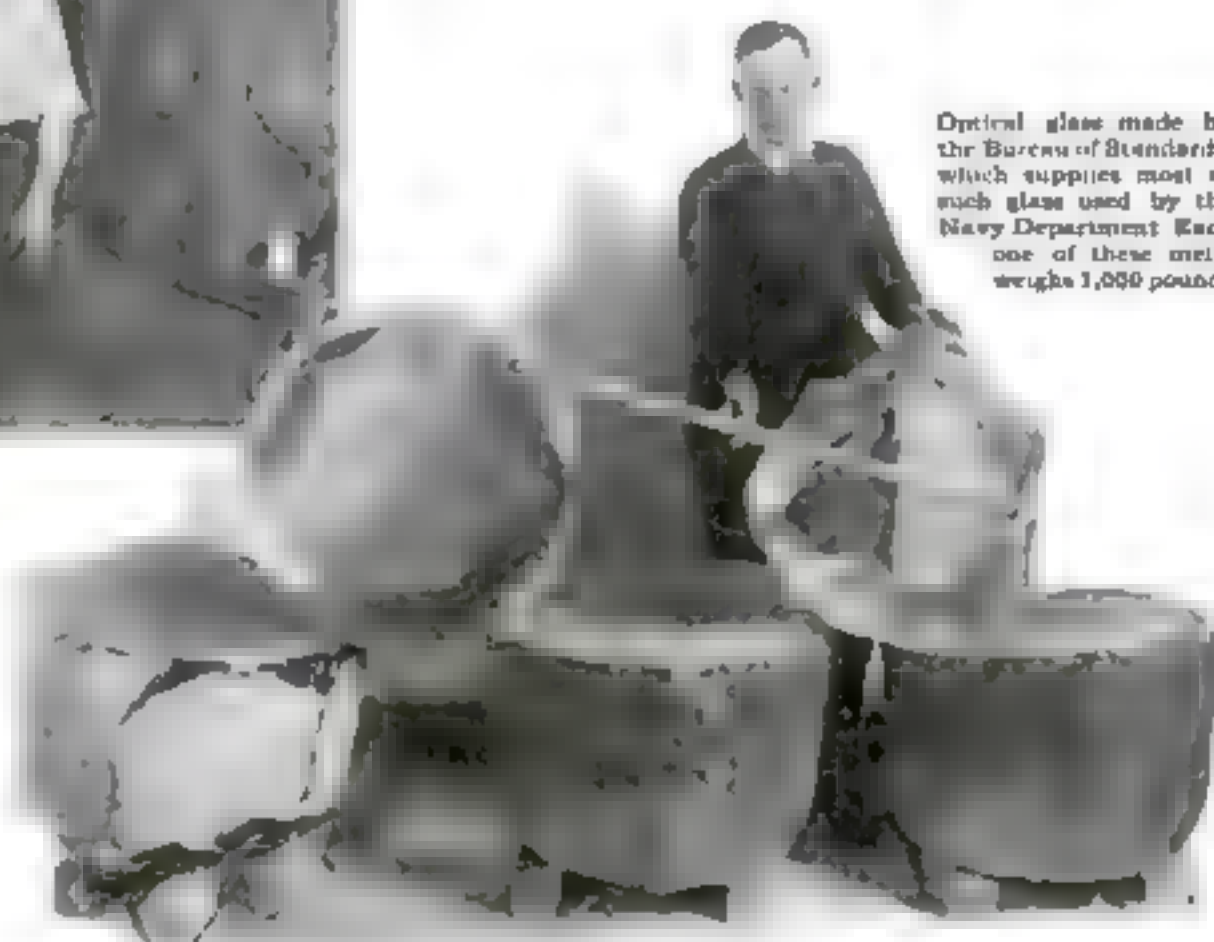
Magic Things We Can

*We Bounce and Bend It, Saw
It Like Wood; Even Stop
Bullets with It!*



Fine Glass Is Still Blown by Mouth

A noted woman glassmaker exhibits her skill at blowing a glass jug. Mrs. Graydon-Stannus makes old Irish handmade glass at her plant in Peckham, Eng., from family recipe 150 years old.



Optical glass made by the Bureau of Standards, which supplies most of such glass used by the Navy Department. Each one of these melts weighs 1,000 pounds.

MOST of us, if we stop to think about glass at all, think of it as a mysterious but important something which is extremely fragile. Many of us, if asked to define what glass really is, would be at a loss to go beyond the statement that it is the most smashable of all the common things we use every day.

As babies, we gaped, fascinated, to see a drinking glass, dropped from our hands, crash in splinters. In boyhood, the crackling of a window pane, hit by baseball or brickbat, gave us a tingling thrill far out of experience. We have come to look upon the stenciled statement, "Glass—Handle with Care," as representing about all we could say of this mysterious material.

I confess, for one, that my thought about glass was limited to some such idea as this until the other day, when I chanced to be talking with a New York architect. We were standing at a window looking out at the Woolworth building.

"Did you know," he said, pointing to the majestic tower rising 800 feet above Broadway, "that fully one third of all the wall area of that great building is made of glass—ten thousand lights of plate glass in five thousand windows?"

I ran my eye up to the top of the building, then looked at him in astonishment as the truth of what he said dawned upon me.

"Yes, it is astonishing," said the architect, "when you think of all that glass withstanding, like brick or steel, the tremendous pressures of gales and storms. Yet I am told that, of all those ten thousand window lights, not more than two dozen break in a year."

Every day for years I had passed by the Woolworth building, but not until now had I ever conceived of it as a tower walled largely by the stuff I always had considered so perishable. From that moment I began to get really acquainted with glass for the first time in my life. I learned that every piece of it, from the

cheap tumbler to the wonderful stained glass window of a cathedral, is full of surprise and the magic of craftsmanship.

From the common sand of the earth, mixed with chemicals and melted by fire men for centuries have fused glass for our use. Through its crystal transparency we view the world about us during most of our workaday hours.

At night, through it, our homes are flooded with light. In our automobiles it lets us see the road ahead. To it we owe our cameras and our motion pictures. In the microscope it has given us eyes to see the wonders of the world of small things. In the telescope it has brought us knowledge of realms billions of miles away. There are many of us who would go through life almost blind but for little round lenses of glass to see through.

GLASS may be fragile, but it does stand use. To list even the common necessities it supplies to us would be an almost endless task.

Such is the magic of glass. Its romance

stretches back somewhere beyond the dawn of history when the secrets of glass-making were first learned. Who discovered them, or where, remains a mystery to this day. We know that almost 5,000 years ago inhabitants of the valley of the Euphrates were making glass baubles. And 3,500 years ago the Egyptians were using it.

In the Harvard University Museum there is a beautiful collection of 9,000 glass models of flowering plants, so perfect that even botanists have thought they were looking at real plants. It is the classic example of the modern glass blower's art. The beauty of these glass flowers, wrought by Leopold and Rudolph Blaschka, famous Dresden glass artists, defies description. Every leaf, every delicate petal, every blend of coloring of the real plant, is reproduced with amazing artistry.



Glass, according to the dictionary, is made of sand and is brittle. But this new "flexible glass" is not made of sand and it bends and bounces! When cold, it pours like a liquid.

FOR centuries Venetian glass has been famed the world over. The making of fine glassware sometimes is called a lost art, but

Do with GLASS

By EDGAR C. WHEELER

It is an art that never has been lost in Venice, where, in the famous Barovier glass factory in the suburb of Murano, as beautiful glassware is made today as was made in the Middle Ages by the ancestors of the present heads of the establishment. One of the artistic specialties of this old firm is the making of liquor flasks in the forms of fanciful animals. Fine "mosaic" glass, into which tiny pieces of colored glass are blown by a secret process, forming designs and color combinations of extreme beauty, is another famous product.

I HAD thought, at the beginning of my investigation, that after some five thousand years glassmakers would have mastered about all there was to be known of the art. The fact is, though, I learned, that some of the most important creations in glass are products of our own times. Only recently, for instance, have we approached fulfillment of the dream of making a glass that will not break.

Necessity, in the guise of a pest of holdup men, gave us the tough, bullet-resistant glass sometimes called "transparent steel." It is clear and colorless as fine plate glass, yet the bank teller who counts his notes behind an inch-thick window of it in your bank is perfectly safe from the gunman who shoots at him with a .45 caliber pistol from a distance of ten feet. Two inches of transparent steel will discourage a .30 caliber steel-jacketed rifle bullet. The glass will crack in fine fan-shaped lines under the impact, but will stop the bullet, not even splintering.

This "transparent steel" is not all glass, I learned. In its manufacture, sheets of elastic substance, like celluloid, are placed between layers of plate glass, and the whole welded together under pressure at high temperature. I have seen it on armored express cars, with marks of bullets on it too, but no bullet holes! And I have seen it in some of the latest automobile models. Its makers, so they tell me, expect that it will be widely used for motor car windows and windshields, and railroad coach windows.

EQUALLY remarkable is the new "flexible glass" or "synthetic glass" invented by two Austrian scientists, who claim that it has all the useful properties of real glass, yet is virtually unbreakable and can be bent to any shape desired.

"Flexible glass" is a condensation product of formaldehyde and urea. In its liquid form it can

be poured and molded as easily as glue. Upon being subjected to a certain degree of heat, it becomes hard and glasslike. It is clear and colorless, but can be dyed easily. It bounces like a rubber ball, and when at last it breaks, it breaks without splintering. The inventors say that, though it weighs only half as much as real glass, it can be produced at the same cost.

STILL another comparatively recent creation is heat-resistant glass. I know my wife has cooking utensils made of this strange material. Although intended originally for apparatus in chemical laboratories, it is found now in almost every home. In this discovery, experimenters were astonished to find that the addition of boric acid and white aluminum rust to the ordinary materials for window glass produced a glass tough enough to stand the most extreme changes of temperature without breaking.

You can fill a tumbler or bowl of this glass with ice water, place it over an open flame and bring it quickly to the boiling point, and the glass will not crack!

Perhaps the most astonishing product of all is glass wool. At first glance you would see little in common between your window glass and a mass of light, fluffy stuff that looks and feels like silk. Yet the panes in your window and glass



So Real You Want to Smell It

This sprig of mountain laurel is part of the famous glass flower collection at Harvard University—flowers so perfect that microscopes reveal even the fine granules on the filaments of stamens!

wool are made of the same material.

The wool is glass spun into threads so fine that it would take 2800 of them, laid side by side, to make a ribbon an inch wide.

Once upon a time this fluff, so light and delicate that it will float in the air, was used in making curls for French courtiers. Today its most important uses are for insulation for filters in the manufacture of chemicals, and for ink crackers.

I HAVE watched the method of producing it. A glass rod is heated in a flame. When a small piece of cold glass is touched to the heated rod, a thread of molten glass sticks to the cold glass. Instantly the thread is fastened to a wheel a sort the size of a bicycle wheel. As this wheel is revolved, the "wool" is spun from the glass rod.

Ninety percent of the space occupied by glass wool is air space. That is what makes the material so efficient as an insulator. If you could look between the

walls of the refrigerator in your home, you would quite likely find spun glass packed there.

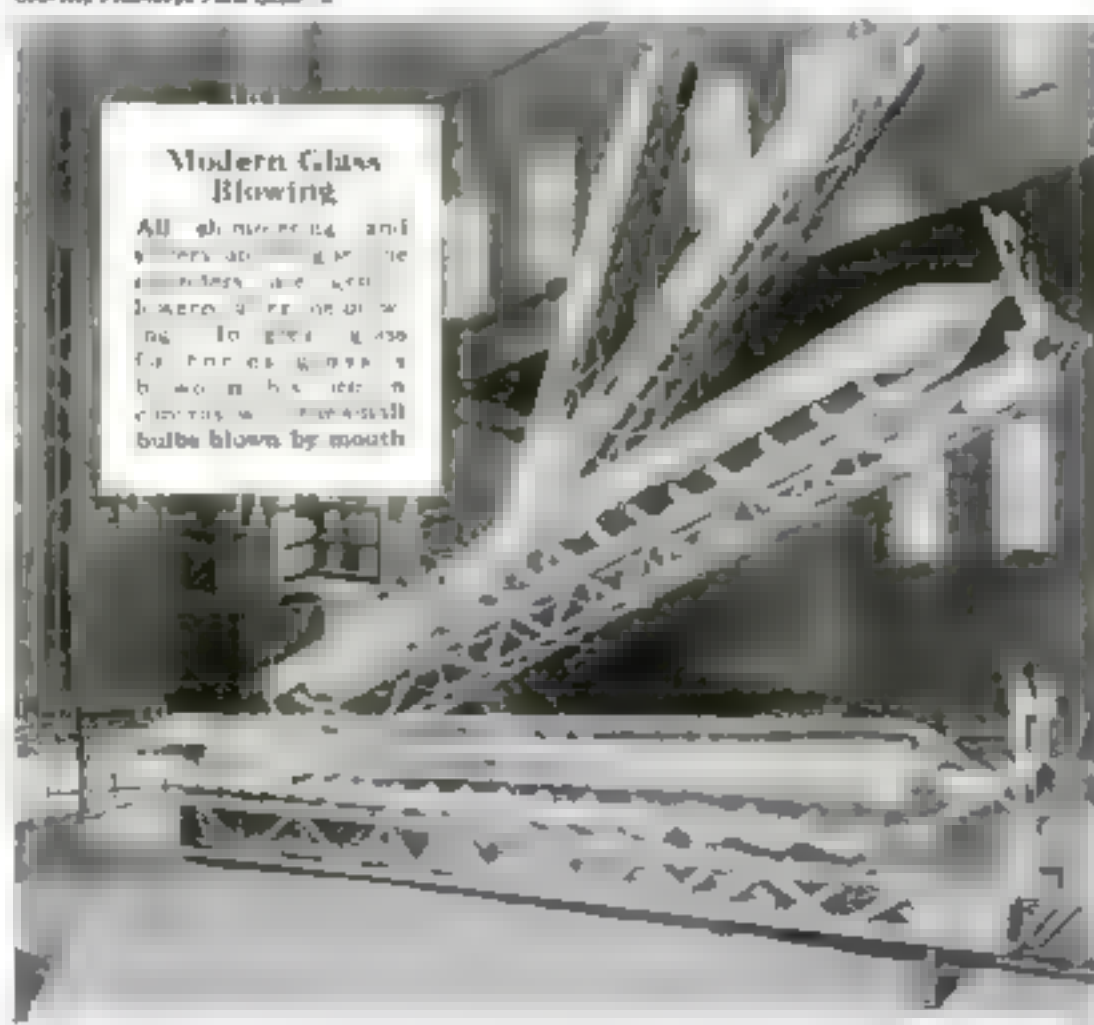
Marvelous as such a product is, it is hardly more so than are the peculiar flat panes of glass through which you look every day.

Did you ever wonder, for instance, why it is that through some windowpanes objects appear wavy and distorted, while through other panes the images are perfect? The answer is this:

The panes which cause distortion are made of glass bubbles blown into cylindrical form and then flattened out. In the process the glass film does not always remain exactly uniform at all points, and distortion results. The clear panes, on the other hand, are plate glass, made by pouring molten glass into

(Continued on page 159)

Courtesy Pittsburgh Plate Glass Co.



Leaders in the May Contest



FIRST PRIZE

"My wife and I are always digging and planning in the garden, but a few weeks ago my wife and I decided to try our hand at the May Contest. We entered the contest and won the first prize of \$100. We are very proud of it and the engraving of it on the back of a 10 cent stamp." — Mrs. W. A. Carter, San Jose, Calif.

Turn to Page 161
for Complete List
of Prize Winners



SECOND PRIZE

Dwight L. Boppe, a railroad telegraph operator of Plymouth, Ind., first noticed the "What a Wrong" Contest while looking through our March number in the Public Library. He entered the March and April Contest and now wins the second prize of \$100.

THIRD PRIZE

Arthur F. Bach (left), an accountant of St. Paul, Minn., wins the \$50 prize. The picture shows him with two of his three daughters, who helped him.

Each One of Them Receives a Cash Prize



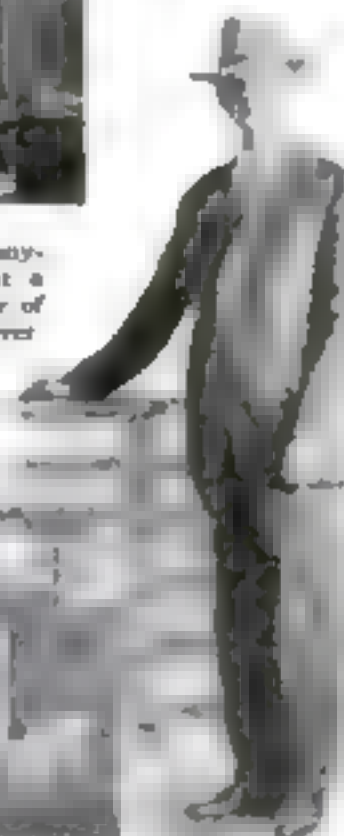
Harold H. Clarke, Victoria, B.C., is a first class constable in the British Columbia Police. "I spent many enjoyable hours solving John's and Mary's mistakes," he writes.

Every evening for two weeks David T. Rayner (below), of San Jose, Calif., studied the Contest picture. He is a horticultural inspector, twenty-nine years of age.



As a school executive, John P. Howe (below) of Gardena, Calif., has found Popular Science Monthly "a storehouse of valuable aids in repairs and construction work."

"I didn't think there was anyone as stupid as I about a house, but I was in favor of Mary and John. However, Mary's error, of course, was a lot studying them."



Frederick J. Bryant is supervisor of manual training at Auburn, Me. He became interested in the May Contest after some of his pupils had tackled it.

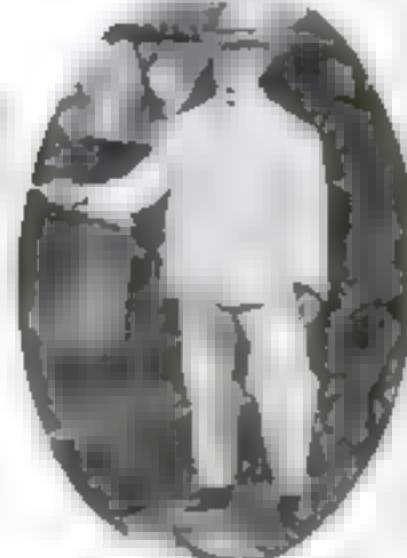


Contests are a hobby with Charles U. Read, a newspaper editor of Upper Sandusky, O. "I have found nothing better to keep cobwebs out of the brain," he asserts.



Instead of a picture of himself, James P. McCauley, of Salem, Va., sent us this snapshot of the playhouse he made for his little girl. His favorite pastime is making doll furniture for his youngsters.

Arlo D. Gerst, a department store clerk of Lebanon, Pa., found "a lot of food for the brain" in working on the Contest. The picture at left shows him with his family.



"Hope to be on your list again next month, as I think I am getting better," writes Dr. Percival W. Darragh, a surgeon, of Leavenworth, Kan. He finds much pleasure and relaxation in puzzles.



JOHN and Mary are enjoying their first camping trip, and in planning their equipment and setting up their camp, they of course made many laughable mistakes. What are they doing, or have done, that is wrong?

What additional errors has the artist made? See if you can find more mistakes than your friends or the other members of your family can. In this, the last of the John and Mary pictures to appear in these pages

What's Wrong *with this* Picture?

JOHN and Mary Newlywed are bidding goodbye to their thousands of friends among readers of POPULAR SCIENCE MONTHLY in this month's issue, and the farewells on both sides will not be uttered without a tone of sincere regret. It is not at all unnatural for readers to feel this way about it, for during the many months they have been with us, this young couple have proven a high source of entertainment, amusement and education by their erratic attempts at house-making and housekeeping.

They tried hard though, and while they made many laughable mistakes, turned many things upside down, and did many things higgledy-piggledy, they were learning all the while. In watching eagerly for their blunders, making note of them, and re-

membering them, interested readers also have gained immeasurably. For the way to Truth, the sages say, lies through error.

John and Mary have their own reasons for leaving us. Experience has taught them much, and now they want

to be alone to work things out their own way, and in the way they have been taught by the thousands of criticisms sent to them from sympathizing readers.

Moreover, it has become increasingly hard to detect them in their daily routine of living, in the commission of error. Even the artist has benefited by practice, and so deprives us of the pleasure of finding his mistakes, too.

So our last glimpse of John and Mary is on their farewell trip. Of course, camping out is new to them, so in this picture they are making several more comical errors. The artist has slipped up here and there also, in his agitation at saying goodbye to his characters.

In next month's issue the winners of the June contest will be announced. Watch for it.

The Most Fascinating Game You Ever Played

A NEWLY discovered pastime, as alluring as cross-words puzzles, as enjoyable as a card game and as scientific as chess, will be introduced in the November number of POPULAR SCIENCE MONTHLY.

There are no intricate rules; you understand the game the instant you see it. You can play it alone, or you can make of it a fascinating competition. In short, it is everything a game should be.

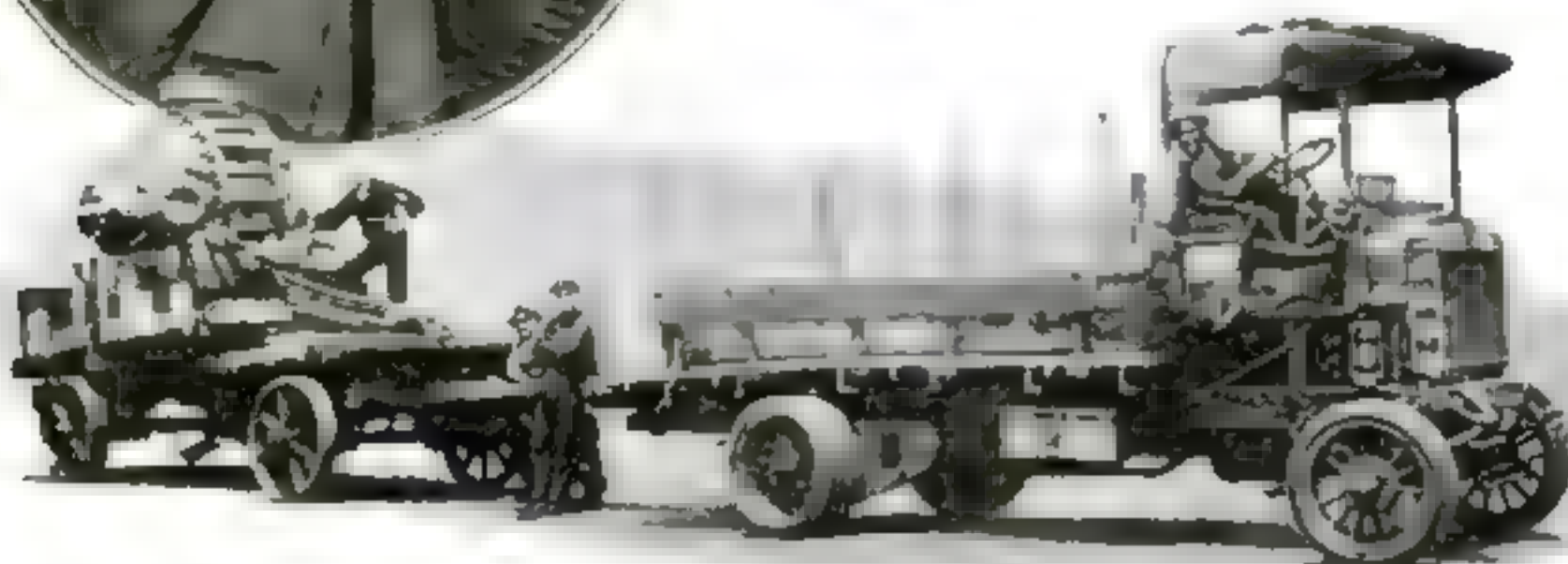
You will find playing this game thrilling for its own sake. But to supply additional incentive for exercising your ingenuity and skill, POPULAR SCIENCE MONTHLY will offer prizes to be distributed among those who realize best the game's possibilities.

Full details will be printed in our next issue.



This Modern Atlas Lifts Tons with His *HEAD*

How a Rigger Hoists Tanks to Dizzy Heights, Swings Smokestacks in Place, and Hauls Steel Girders



By
GEORGE LEE DOWD, JR.

ATLAS of ancient mythology lifted the world on his shoulders. Richard R. Doughty, Atlas of modern times, lifts colossal loads with his head.

"Dick" Doughty is a veteran boss rigger. No doubt he might claim the title of champion hefter and hauler of America. For during half a century of thrilling adventure and hair-raising achievements, he has used his head and neck hundreds of times to beat the law of gravity. Juggling hundred-ton dynamo and hundred-foot smokestacks has been child's play for him. He has hoisted mountainous loads up the sides of skyscrapers, and has dragged thousands of tons of steel girders for great bridges and buildings. In almost every part of the country he has performed feats that might have broken the backbones of the giants of old.

To him each new lifting job is not merely a spectacular test of brawn, it is a fascinating challenge to wit and skill. This much I learned the other day when I found Doughty before a downtown New York skyscraper, superintending the job of raising a twenty-ton steel water tank to a roof above the twenty-second story.

A section of the street had been blocked off by lurid "Danger" signs, and in the center of this cleared space stood the gray-haired, weather-hardened figure of the boss rigger, barking orders to his men. Curious pedestrians, lining the opposite sidewalk, craned their necks to watch the huge cylinder sway in the clutch of Manila ropes as it was dragged

One of His Lighter Jobs

When an Italian naval officer went shopping in New York and bought an 18-ton gyroscope, the job of getting this trifling purchase to the ship was entrusted to Dick Doughty and his riggers. This is how they did it. Above at left—Richard R. Doughty himself.

upward inch by inch. Three or four pygmy figures scurried perilously on narrow beams high above the deep canyon, or swung like monkeys on the ropes of the hoisting tackle. What if a slay should slip or a knot loosen, and the whole twenty-ton burden come hurtling down?

Doughty jerked a pipe from one corner of his tight-lipped mouth to the other.

"Yes, sir," he said, without shifting his gaze from the job overhead, "you can move any load anywhere—if you use your head to do it. If you can budge a thing at all, you can move it any distance. That's the idea. Sure, it's easy to move a safe, or a piece of machinery or a tank to the top of a building. It's as easy as playing pinchle—if you know how."

JUST then one of the pygmies up near the sky slid nimbly down a rope, braced his feet against the wall of the building, pushed himself violently outward, then swung back again in a swift, easy arc into a window. The spectators gasped. Dick Doughty smiled approvingly.

"Now that's what I call headwork," he said. "Every one of my riggers up there has a level head on his shoulders. They have to have, or they wouldn't be riggers. That was a sailor's stunt," he went on. "Lots of these riggers come from

ships. They can do anything with ropes and knots, so rigging comes natural to them.

"Of course there's some danger to it, sometimes. I'll never forget the time I took a tumble"—

And Doughty related the story of his narrowest escape from death. It happened when he and a crew of riggers were working inside a building under construction on Pearl street, New York, hoisting a five-ton lithograph press up a shaft to the fifth floor.

ROPES strained, tackle creaked, and the press slowly rose as the pulley block gripping the rope swung around the press climbed to meet another pulley block fastened above the fifth floor. A final tug, and the two blocks met. And then Doughty discovered they had made a miscalculation of six inches. Two timbers fastened beneath the press to serve as skids prevented swinging the machine onto the floor.

"Take off the skids," Doughty ordered. The riggers began to unscrew the bolts—three bolts to a skid. Doughty himself climbed out on one of the swaying skids and loosened an end bolt. Meanwhile, unknown to him, one man had removed the middle bolt. Doughty might just as well have been sawing himself off the end of a limb. Without warning, the skid fell. Doughty dropped like a plummet down the shaft. To the horrified riggers it looked like sure death.

But as he plunged downward, Doughty clutched at a rope that dangled from the press for three stories down the shaft. The rope burned through his fingers, yet

he tightened his grip. His hands, torn to the bone by the friction, clutched tighter and tighter, until two feet from the end of the rope he stopped his plunge—two stories in midair!

Still he hung on, while the shaken riggers pulled him to safety. When his hands had been dressed he went back to work. The job was finished that night.

If this adventure illustrates the hazards of the rigger's calling, it also gives some idea of the courage and resourcefulness by which Dick Doughty has come to excel in the science of lifting and moving heavy loads. By headwork he has lifted himself from his starting point as a truckman to that of directing owner of an important industrial concern.

In the list of jobs he has done successfully were the hauling of 10,000 tons of steel cable for one of the Brooklyn bridges—his first big contract, the moving of thirty vault doors of the Federal Reserve Bank of New York, weighing from fifteen to eighty-five tons, the hoisting of elevator and ventilator machinery thirty-five stories to the top of the Singer Building, the suspension of the 280-ton propeller shaft of the liner *Lerathan*.

EVERY one of these gigantic tasks was full of adventure, danger, romance and heroism. That they were accomplished at all, Doughty told me, was due largely to the fine skill and courage of the riggers who worked with him.

"Take that Federal Reserve Bank job, where we hauled the largest bank vault in the world," he said. "That was one long grind—nothing but hard work and obstacles at every step. First, we had to

get permits—permits to cross bridges with our heavy tractors; police permits to block streets for hours at a time while we rolled and lifted the pieces into place; permits to put our heavy trucks on the ends of ferryboats and have the ferries turn around in midstream so that our end could be docked first.

"THEN we had to figure out safe ways of shipping the huge parts of the vault across country, over a river, and through the streets of the city.

"The last lap across the city was the toughest of all. We had to pick a route to the bank over cobblestone streets, for a heavily loaded truck sometimes will sink into asphalt pavement. Each door was lifted by a derrick from the lighter and placed on a special trailer which was pulled by two trucks as far as the streets were level. Whenever we came to an upgrade, seven more trucks joined in the pull. Arriving at the bank, the door was jacked up off the trailer and under it we placed huge timbers. By means of rollers fed under the timbers, the big slab of steel was moved slowly into the building over a floor especially reinforced by heavy beams.

"The special trailer we used to carry it we call the 'Infant'. It can carry one hundred and twenty-five tons. Some baby, that! The rear axle, of manganese steel, is ten inches in diameter. Each wheel is cast in a single piece of steel, and the rear ones weigh three thousand pounds apiece.

Every foot of the streets over which the 'Infant' hauled these huge vault doors was laid with steel plates. We picked up the plates from behind the trailer and put them down again in front."

The most ticklish job Doughty ever tackled, he told me, was lifting a sixty-five-ton dynamo by a crane that was supposed to lift not more than fifty tons. The problem called for all his ingenuity, for the dynamo had to be hoisted forty-five feet in the air, then carried 125 feet over a vast power house floor filled with electric engines.

DOUGHTY determined that, if tenderly handled, the crane could be made to carry the extra load. The way he went about it was this: When the end of the crane cable had been made fast, the dynamo was raised for a distance of only thirteen inches off the ground. Immediately riggers slipped four timbers underneath the suspended machine. Then the crane let the load down one inch to the timbers, which held it firmly one foot off the floor. Again the load was lifted thirteen inches, four more timbers were slipped beneath, and again it was lowered one inch to rest.

This process was repeated, until the tower of crossed timbers had risen to a height of forty-five feet. The next step was to swing the load overhead across the room and above the tops of whirling machinery. This done, the crane halted the load directly over a spot where had been prepared a second



How Would You Do It?

The problem of erecting this 22-ton, one-piece, steel smokestack. Doughty confesses, gave him a nightmare or two. He finally solved it by borrowing an idea from the circus.

forty-five-foot crib of twelve-inch timbers. The riggers slowly let the load descend, removing the timbers layer by layer, until at last the dynamo rested on the spot where it was to be installed.

Thus, in lifting and lowering, the fifty-ton crane never was required to suspend the load more than thirteen inches above a resting place.

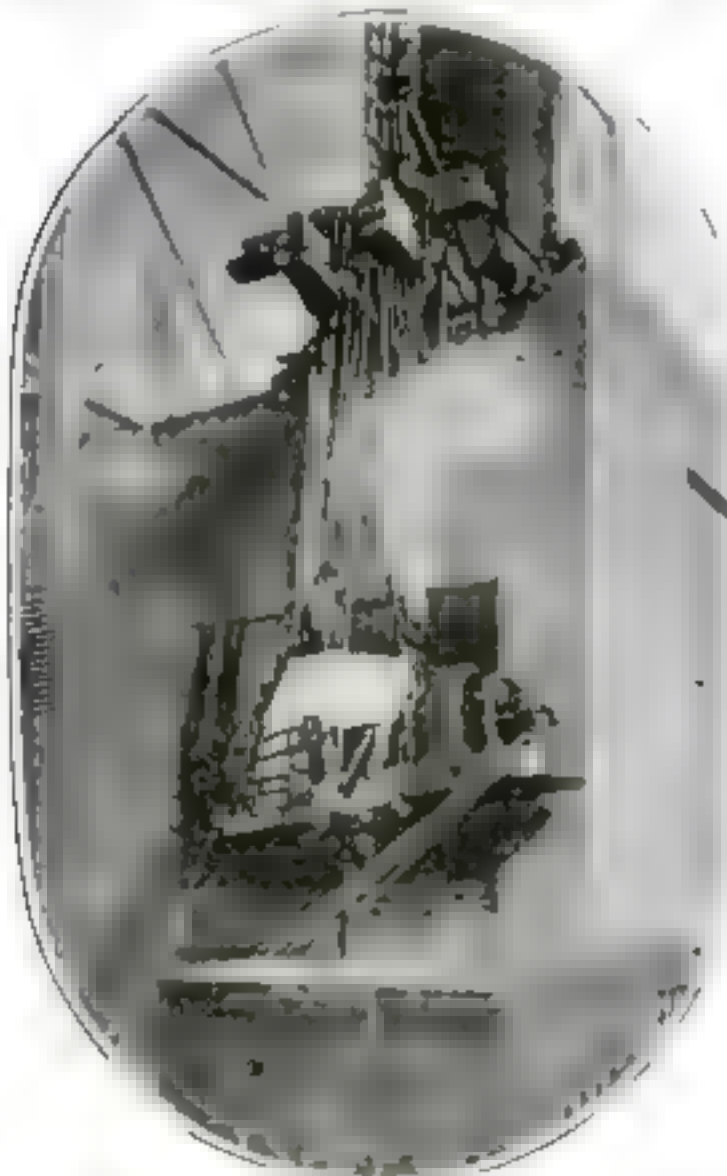
"What was the biggest job you ever tackled?" I asked.

"That would be hard to say," Doughty replied. "But the one job that was most important to my mind was one we did during the war. A crew of a hundred of my riggers worked night and day for seven months to suspend the two hundred and twenty-ton propeller shaft of the *Lerathan* above its housings and bearings. The purpose was to let American engineers regrind the shaft which enemy officers had put out of business by dropping emery into the shaft bearings."

"WERE you ever stumped—ever start anything you couldn't finish?" I inquired.

Doughty knocked wood.

"Never," he replied. "But there was a twenty-two-ton, one-piece steel smokestack at Stamford, Connecticut, whose erection gave me (Continued on page 162)



Every Job Presents New Dangers

When Doughty's riggers hoist a safe or a dynamo to the upper story of a New York skyscraper or water tank to the roof, crowds gather—and gasp—to watch them.

Science Continues

Invisible Finger Prints Detected

Helium At Last Is Solidified

More than half a century ago the element helium was discovered. In 1908 a Dutch scientist liquefied it. But it was not until this year that another scientist, also Dutch, at last succeeded in solidifying it. He is Professor W. H. Keesom, shown here with a test tube containing the first transparent, solidified helium. Exposure to high pressure and extremely low temperature produced the transformation.

uated by a series of tests given to 542 women and 542 men, all college students, under the direction of the Psychological Laboratory of Johns Hopkins University.

It was found that in the task of substituting letters for symbols the women, on the average, could do more in a given time than the men. The latter, however, were more accurate in judging in advance the amount of work they could do in the time allotted.

For License Tags Easy to Read

FITTING our millions of motor cars with license plates that can be read easily presents a problem. Science recently offered a possible solution.

James D. Weinland of Lehigh University employed fifteen college students to determine what combinations of letters and numerals they could read most readily. Exposing different license plates to view, each for one fifth of a second, he found that while the readings were 90 percent correct when only five numerals were used, the accuracy of reading dropped to 50 percent when the numerals were increased to six. These letters and three numerals in combination resulted in a score of 76 percent when the numerals preceded the letters, and 70

percent when they followed the letters. For four letters followed by two numerals, the result was 85 percent correct readings, but with three letters and four numerals, the score dropped to 45 percent.

With these findings as a basis, Mr. Weinland says it is possible to obtain as many as 20,000,000 license number combinations, all of them fairly readable.

Water Gas May Give Us Our Future Gasoline

FROM the chemical laboratory comes the promise of an important new source of gasoline in the future. This source is water gas, which forms a part of most city illuminating gas, and is obtained by passing steam over hot coke.

As the result of experiments in the Kaiser Wilhelm Research Institute for Coal Products in Germany, Professor Franz Fischer reports that by using a catalyst, or substance which accelerates chemical reaction, not only gasoline, but wood alcohol, vaseline, and other related products can be obtained from water gas.

New Switch Cuts Huge Current Flow Like Scissors

PROGRESS of electrical engineering has been marked by two important developments in recent weeks. One of these is the invention of a vacuum electric switch by R. W. Sorenson, of the California Institute of Technology. The other is an announcement that the research committee of the American Institute of Electrical Engineers has undertaken a world-wide study of means to prevent by insulation the leakage of electric current.

The perfection of the vacuum switch promises great economies in industry, where the problem of interrupting the flow of thousands of horsepower of elec-



On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our everyday problems.

Says Our Towns Could Reclaim Iron Junk by Electrolysis

MILLIONS of tons of iron now rusting in trash heaps throughout the country can be reclaimed by electrolysis, asserts Charles P. Perin, New York mining engineer, in a recent report of his to the Engineering Foundation.

"Discarded iron objects, from cans to automobile bodies, are increasingly disfiguring the countryside, especially near communities," he says.

"Large tanks of iron solvent, ferrous chloride for example, could be maintained in convenient places, into which these wastes could be dumped. Then the iron could be recovered by electrolysis." In other words, if our villages and towns saw that iron junk was dumped in such tanks, they would find a considerable addition to their treasures every year.

Considering that twenty million tons of iron and steel are destroyed by rust every year in the United States, the suggestion appears to be one of great value, especially since Mr. Perin points out also that electricity can be made to produce iron that will rust less rapidly.

Men Have Better Judgment, Women Work Faster

AT LAST you'll have to admit that your wife can work faster than you can. Likewise, she must agree that your judgment is better than hers—in the long run.

Such conclusions, at least, are substan-



Where Was the Home of the Hominid's Fourteen-Inch Ancestor?

Hominids were no bigger than cats countless ages ago, and had five toes. But where was their favorite stamping ground? Science is trying to find out. Dr. James W. Gid-

ley, paleontologist of the Smithsonian Institution in Washington, is engaged in looking up this interesting fourteen-inch ancestor of man's most faithful and helpful friend.

Its Conquests

and Helium Is Solidified

tric current has involved the use of enormous oil-immersion switches, sometimes occupying acres of ground. In contrast, Professor Sorensen's switch operates in a small glass vacuum tube. It works on the principle that electric current will not travel through a vacuum. In recent tests the switch instantly stopped a current of more than 50,000 horsepower.

In the study of electrical leakage, the American Institute hopes not only to prevent economic waste but also to reduce the danger of short circuits.

Speed-Mad Engineers Put Up Bridge in Ten Minutes

ALMOST every day we hear of some man's skill and ingenuity. A few weeks ago, for example, engineers of the Pennsylvania Railroad removed an old bridge at Tilgha, Ohio, and replaced it with a 200-ton steel bridge—in ten minutes!

The new bridge had been assembled near the site. Immediately after an express train had passed over, the old bridge was quickly ripped out and the new steel structure was slipped into place. Two minutes later another train passed over, operating on regular schedule.

It's the Biggest Thing We Know

ASTRONOMERS at Harvard College Observatory are studying what they say is the largest thing known to science—a superuniverse so far out in space it takes ten million years for light from its center to reach us, yet so vast that a light ray would require two million years to cross it.

The largest thing is described as a cloud of galaxies containing at least 100 spiral nebulae or separate universes like the one of which our sun and stars are parts. It was in one of these nebulae, known as Messier 61, that the German astronomer Max Wolf discovered the farthest new star described in last month's issue of POPULAR SCIENCE MONTHLY.

Where Is Our Food Coming From?

PROBABLY never before in history have people been so concerned about what they should or should not eat as they are today. Now, however, Dr. Harrison E. Howe of the National Research Council warns us that the concern of the immediate future will be not so much with what we shall eat, but how to get enough to eat.

By 1930, he says, the

Father and Daughter Scientists War on Mosquito

Two scientists, father and daughter, are engaged in warfare in London against one real enemy of their country—the mosquito. Mowat Hargreth, of the College of Pestology, is carrying on the campaign with his daughter as assistant and microscopes and test tubes as weapons.

United States will have about 150,000,000 people to feed. The needs of such a population will require the tilling of at least 38,000,000 more acres of land than at present. And to add to the problem, the vitality of the soil now under cultivation is decreasing steadily.

Uncle Sam, warns Dr. Howe, must make rapid strides in the science of soil conservation to meet the coming need for vastly larger crops.

We're Immortal—Potentially

WHY do we need to die? Interest in this age-old question has been renewed with the discovery, by Professor Max Hartmann, of Berlin, of a microscopic one-cell creature which apparently can be made to live forever by careful treatment, which includes peeling off portions of the creature's

body at intervals. Professor Hartmann claims to have kept it alive for many times the length of its normal life. If the same results could be obtained with human beings, he says, our lifetime could be extended indefinitely.

Married Men and Old Maids Make Best Workers

WHO are the best office workers? "Married men and old maids," answers Hubert D. Brown, chief of the United States Bureau of Efficiency, from his experience with employees in Government offices. "Bachelors and boys, married women and flappers are not so good."

The Government, he has found, has no better employees than married men, probably because they have learned the art of give-and-take from married life.

The old maids are ideal, he adds, because woman's efficiency increases as the thought of marriage fades—"she mothers her job."

Flappers, he contends, let their minds wander, think too much of men, stop work to powder their noses, and constantly "fit about."

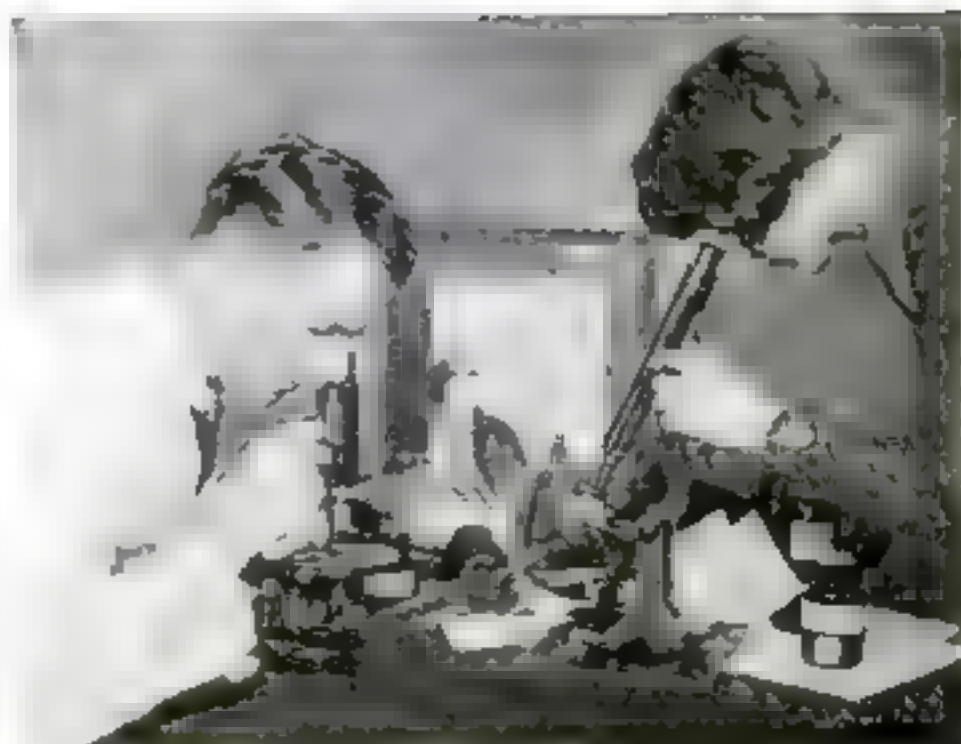
Mr. Brown observes further that widows are unsettled and easily disturbed.

Vindication for Meat Eaters

SCORE one point in favor of the meat eaters. After a thorough physical examination of Vilhjalmur Stefansson, a Chicago physician reported that the famous Arctic explorer was in exceptionally fine physical condition despite his exclusive meat diet while in the Far North.

"Neither Stefansson nor any of his men, so far as we could determine, suffered any ill effects from long-continued meat diet," says the report of the examining physician.

AN UNUSUAL development in aviation which comes from Germany is a new type of motorless glider, designed to imitate the structure and soaring action of large birds. Its wings are jointed, and it is much larger than previous types of gliders.



It Detects Finger Prints You Can't See

Finger prints that can't be seen with the eye may yet prove strong evidence against criminals, as the result of a chemical machine invented by Arthur E. Bergquist, of Lindstrom, Minn. It is said to detect and develop marks on paper, leather, or cloth. A police official is shown above using the device, the top picture showing prints brought out on leather bag. Turning a crank operates it.

When All Things Are Possible

Miracles of our times seen as products of the spirit of mechanical ingenuity Wonder stories of the stars and sea Reviews of fascinating new books

By THOMAS M. JOHNSON

"Our Times"

By Mark Sullivan. Published by Charles Scribner's Sons

"IT'S impossible—it can't be done!"

How often, in the world's history, have people said that! We say it less today, perhaps, than ever before—the "impossible" has been accomplished too often, right in our own time and before our own eyes. But it is a tricky lesson to learn.

We take automobiles for granted today. Last year there were 17,000,000 of them in the country. If anyone had predicted this at the turn of the century, he would have been laughed at.

The first automobile appeared in America in 1892, and in 1893 there were just 300 of them. Here is what the *Literary Digest* said in 1899, according to the first volume of *Our Times*, Mark Sullivan's series depicting recent history.

"The ordinary 'horseless carriage' is at present a luxury for the wealthy, and, although its price will probably fall in the future, it will never, of course, come into as common use as the bicycle."

In that year, one American in seventy bought a bicycle. In 1921, only one American in 934 bought one! This amazing change has been brought about, Mr. Sullivan believes, by the vision and ingenuity and energy of ingenious Americans who kept forever tinkering until they had made automobiles that almost anyone could own and drive.

IN MANY American towns and villages the local mechanical genius—sometimes the local "nut"—devoted his whole being to this new European device. The first stage of the automotive industry in America was that of isolated persons, each making a single machine.

Ford was a mechanic in an electric power house, Winton was a bicycle repair man, Franklin was a die caster, Pierce made bird cages, bicycles and refrigerators, and Haynes was field superintendent of a natural gas company. The Studebaker car was the product of a wagon factory, the Peerless of a clothes wringer factory and the Stanley was developed in a photographic dry-plate factory.

The same sort of ingenious, tinkering Americanism, in the person of the Wright brothers, working in a small town bicycle shop, developed the airplane.

On October 25, 1903, Mr. Sullivan points out, the brothers made their first airplane flight at Kittyhawk, N. C. Be-

fore that, however, Dr. S. P. Langley, secretary of the Smithsonian Institution at Washington, had built a machine and tried to fly it. After many unsuccessful attempts that drew public attention, he was ponderously rebuked by some magazines for wasting his time. But in 1914 his machine was dusted off and successfully flown by Glenn Curtiss. Again the impossible had been accomplished!

Even in "up-to-the-minute" New York, there were men not so long ago who said "impossible." Mr. Sullivan reminds us, and retarded the building of subways. When in 1896 the New York

age reader will find easy to understand.

A star's nucleus is formed by gas at high pressure, gathered together by gravity and condensed into a glowing ball, so that stars when young are huge and red. As stars contract, they rise in temperature, but when too advanced condensation retards this contraction, the star cools.

How large are the stars? The diameters of a few have been measured and found to vary from a few thousand miles to a good many million. Our sun is only a medium-sized star, and its diameter is 866,000 miles.

What are the stars? Mrs. Grondal defines it this way: "The stars are distant suns, and the sun is a nearby star."

Interest in the planet Mars has always been strong, and Mrs. Grondal tells the latest theories of some authorities regarding it. They believe, she says, that Mars is an old planet whose water is rapidly disappearing, so that soon the planet will become a desert. There are, however, snow caps at either pole which melt in the summer. The water is guided to points where it is most needed, by the famous "canals."

No less interesting is what Mrs. Grondal says of the moon. The gray areas on the moon which we can see with the naked eye are not seas but probably

lava plains. The yellow or green tints revealed by the telescope may be due to vegetation or colored volcanic material. There are more than 100,000 craters on the moon visible from earth.

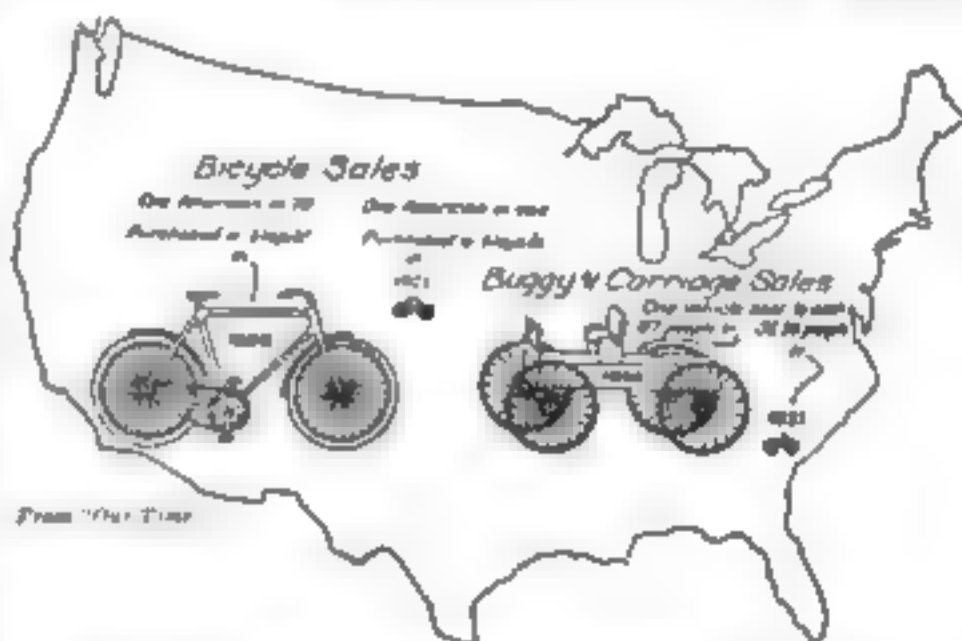
The men in the moon—if there are any—Mrs. Grondal explains, would be one sixth as heavy and able to jump six times as high as anything earthly, because the surface gravity of the moon is only about one sixth that of the earth. But if there is a man in the moon now, he must be unhappy for the planet is nearly dead and lacks air, water, life and even sound!

"The Arcturus Adventure"

By William Beebe
Published by G. P. Putnam's Sons

A TREASURE ship sailed into New York harbor not long ago—such a treasure ship as had never been seen before. It brought back bright jewels from the deep sea, and from strange islands of the Pacific, and from the Sargasso Sea, once known as whirlpool of missing ships.

The homcomer was the *Arcturus*, sometimes called a "floating laboratory." It was fitted out by William Beebe, tropical research. (Continued on page 163)



From "Our Times"

In 1899—to complete this graphic illustration—there was one automobile to every 27,700 of us. In 1921 the ratio was one to every eleven!

courts had refused to approve a subway project, the decision said: "The probabilities indicate that, after sinking \$31,000,000 in it without being able to complete it, the enterprise would have to be abandoned. All that beheld it would begin to mock, saying 'this city began to build and was not able to finish.'"

Nor did anyone then foresee radio as we know it today, with more than 3,000,000 receiving sets in the country.

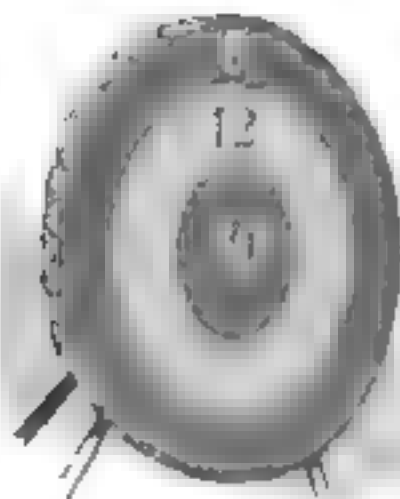
All these developments of the turn of the century have been in large measure the work of men who temperamentally could never agree with a majority that said, "This thing is impossible."

"The Music of the Spheres"

By Florence Armstrong Grondal
Published by the Macmillan Company

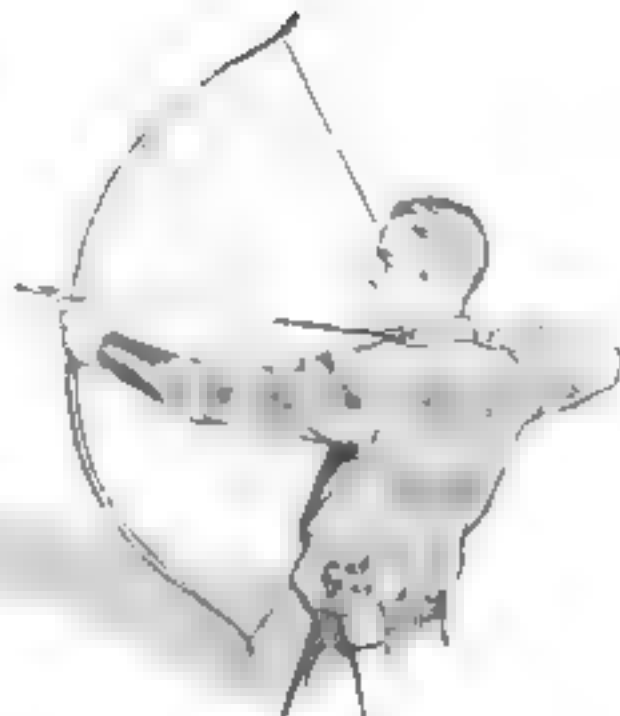
WHAT are the stars? Are they other worlds? Of what are they made? Why do they twinkle? We are all star gazers sometimes, and to us all these questions have come.

Some of them at least are answered in a new book, *The Music of the Spheres*, that tells the results of the latest astronomical research in a way that the aver-



For Mental Sharpshooters

WHAT is the fewest possible number of shots which this archer can score on the target to produce a total that will average seventeen points to the shot—all shots to score? If you have a "good head for figures," you should be able to perform this mildly mathematical feat in six minutes. The answer appears on page 164.

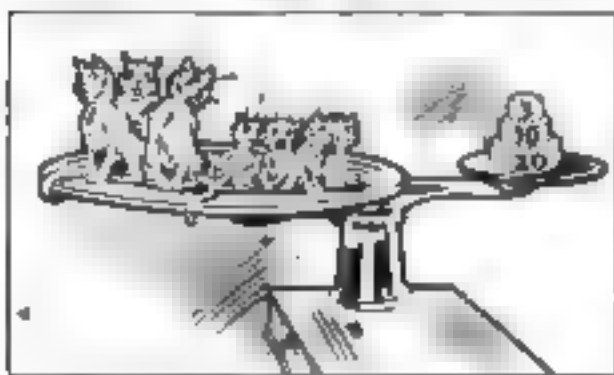
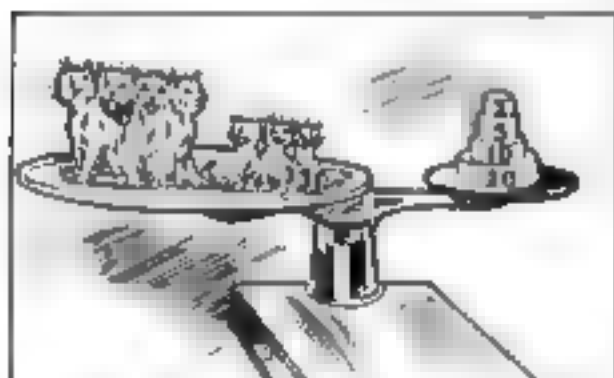


These Sam Loyd tests are appearing from month to month in **POPULAR SCIENCE MONTHLY** in response to requests from many readers. They are the best that the master puzzler can offer.

Six Ways to Test Your Mind

These Sam Loyd Puzzles Challenge Your Brain Power and Offer Stimulating Entertainment

IN THE six tests on this page Sam Loyd, the world famous puzzle expert, shows you how you can get a line on your mental equipment, and at the same time have a lot of real entertainment in doing it. In the form of challenging puzzles he offers a new and fascinating way to measure your brain power and put an edge on your wits. The problems are of different types, each calling into play some one of your mental faculties. A time limit adds the zest of competition.



Do You Think Quickly?

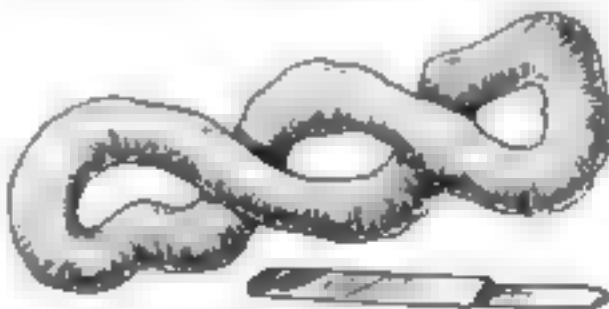
FOUR cats and three kittens weigh as shown in the upper sketch. Another lot, consisting of four kittens and three cats, has another weight. Now, if the cats all weigh the same, and the kittens likewise, what are their respective weights?

If you reason logically and swiftly, three minutes will yield the correct answer, which appears on page 164.



This Takes Sharp Eyes

IF YOU are good at taking short-cuts, and if your eyes are accurate guides, you should solve this in four minutes. The sketch represents a reef-strewn zone. You are to discover a route from the top line of the rectangle which makes a straight run to one of the side lines and thence straight to the bottom line. This would admit of a ship's passage in two straight tracks with but one turning point. The solution is on page 164.



Food for Your Ingenuity

INTO how many pieces can you cut the doughnut by drawing mentally one straight line across it? Here's a test of your ingenuity and sharpness of perception. Three minutes is a reasonable time allowance for quick wits. Turn to page 164 for the solution.

A New Test for You

Don't miss the remarkable new game which will appear in next month's issue. It's simple, yet scientific.

Are You Clever with Words?

IF WORDS come quickly at your command, and if you're resourceful in finding the right word for the right place, ten minutes of mental gymnastics should solve this one.

A certain letter, when sprinkled through the following line, will turn it into a complete sentence:

A D E N I I C A N D O C K

It is necessary to use the letter several times in forming the words of the sentence. You'll find the answer on page 164.



Have You Imagination?

CAN you translate into English these pictorially expressed "good resolutions," and do it in ten minutes? If so, wit and imagination will be strongly indicated in your mental make-up.

Just for a starter, each one of the resolutions begins with the word "Be." Now see how quickly you solve them, then compare your solutions with the answers on page 164.

The Tamest Zoo in the World

Where Animal Skins in Lifelike Poses Trick the Eye



Otter skins lined up for a race—but they'll never get past the starting point, for they're only products of skilled taxidermy, produced by one of the Sauters.

CROUCHING wolves with snarling fangs bared, that remain curiously still, however, and never leap, facing ostriches with craning straining necks, that nevertheless are lifeless to your touch—these are some of your curious impressions when you visit the strange menagerie of Fred Sauter and his son, in New York City.

The Sauters are taxidermists of extraordinary skill and originality. The elder

Sauter learned the profession from his father, and the son is preparing to carry on the business after his father retires. Their creations are so lifelike that nervous visitors sometimes jump, thinking the animals are about to spring at them.

A desperate battle with a ferocious wolf? It looks like it—but it's only young Fred Sauter posed with one of his own remarkable creations.

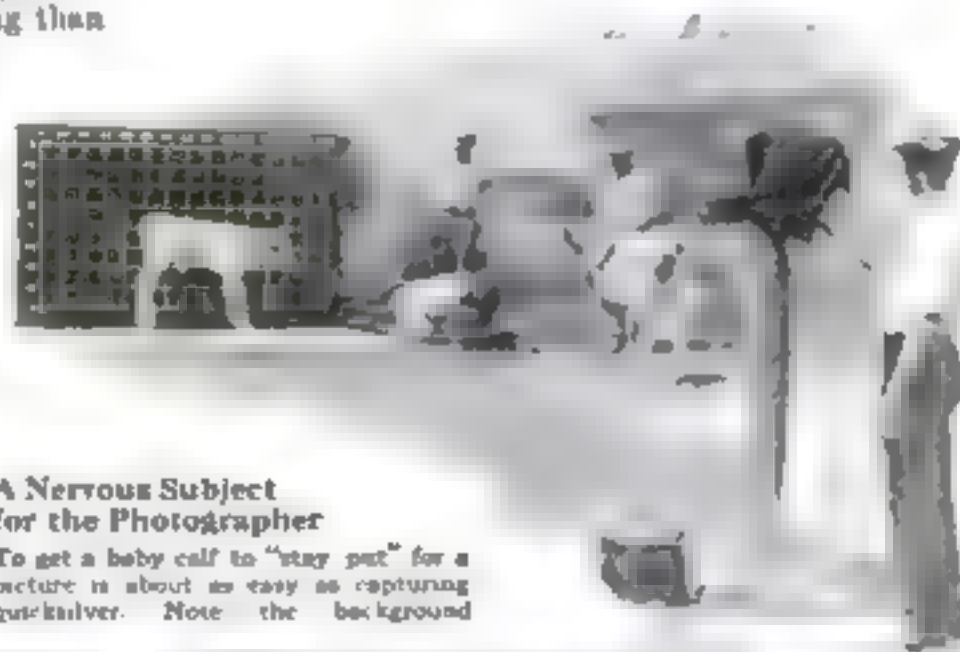
There are no conventional mountings, made in conventional poses. They have studied the animals themselves and birds and fishes, too. They have learned their mannerisms and instincts, how they fight, eat, play. With care and skill they reproduce these attitudes.

The lower picture shows the stages in a deer head mounting. First Sauter makes the head outline of wax; next he attaches the antlers and head skin. Then he thickens the neck with straw and twine, and last puts the skin over that.

Calves Pose for Camera to Develop the Perfect Cow

"SHOOTING" a dynamite explosion isn't any more nerve racking than photographing a nervous calf, say the government camera-men whose job it is to photograph animals during scientific breeding experiments. Pictures of this kind have no value unless the calves are photographed to an exact scene and in identical positions, which it is most difficult to do.

According to the method worked out by the Department of Agriculture, the calves are posed against a background carrying a scale ruled in squares. Pictures are taken of each animal once a month



A Nervous Subject for the Photographer

To get a baby calf to "stay put" for a picture is about as easy as capturing quail. Note the background.

until it is fully grown. Comparisons enable the scientists to note the relative conformation and growth, and furnish valuable records through succeeding generations.

The camera is set on top of a post planted in a concrete base, and the background is bolted on a concrete platform. This makes the distance between the camera and animal unchanging, so that all of the pictures are taken on the same scale. The pictures are used to guide cattle breeders.



Three pictures of the same animal, taken at twenty-three days, five months and one year of age. Against the same background and always in the same pose, the pictures revealed changes in growth, such as, for example, the slope of the back.

Now They Grow Oysters on Trees

*Discovery of Surprising New Way to Raise Bivalves
Saves a Vanishing Industry*

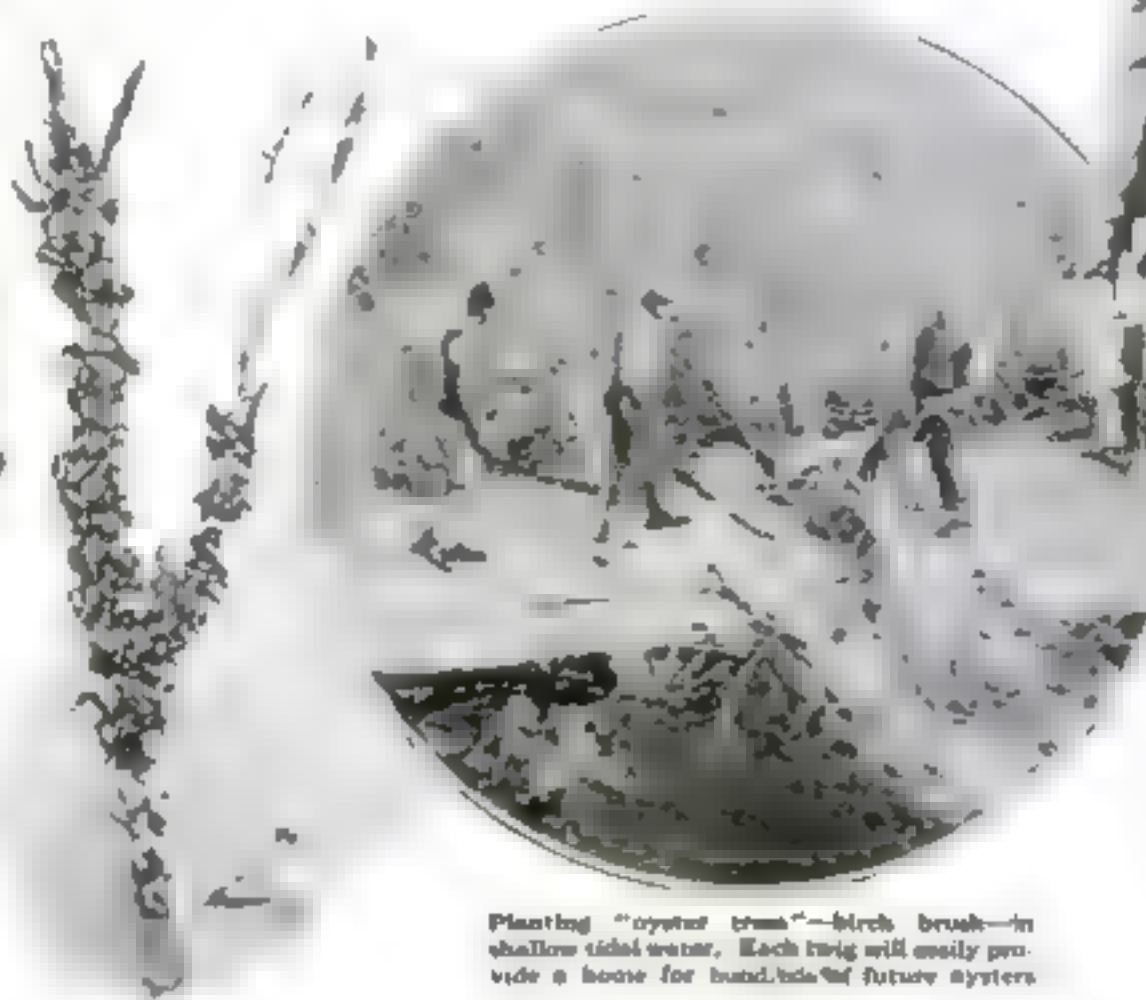


Section of sewer pipe to which young oysters attached themselves, in tests to find the best means of raising them

IF YOU happen to walk on an ocean beach at low tide and see a gang of men working with a saw-load of shrubs don't laugh if someone tells you the men are planting "oyster trees." For that is exactly what they are doing.

Growing oysters on trees is an accomplished fact though quite new. The oysters that you eat for dinner very likely spent their youth clinging to the twig of a birch in the shallow waters of a tidal flat.

The development is part of a scientific program for making sure that your grandchildren, too, will have oysters for dinner. The oyster population has a heavy death rate, and several other influences have so devastated the supply of bivalves that the Government feared it would be exhausted.



Planting "oyster trees"—birch brush—in shallow tidal water. Each twig will easily provide a home for hundreds of future oysters



Herbert F. Frytharck (above), of the U. S. Bureau of Fisheries—the man who developed the "oyster tree" idea

Oysters form the basis of the most valuable fishing industry in the United States, with an annual return of nearly \$13,000,000 to fishermen. It was thought worth while to save it, and the best way to do it was to provide a suitable place for baby oysters to develop and reach maturity.

When from fourteen to eighteen days old, oyster larvae attach themselves to a smooth surface and remain fixed. The face of a submerged rock is a favorite resting place. A common practice of oyster growers has been to plant empty

oyster shells. Other types of "support" or "collectors" have been tried, including split drainpipes, flowerpots, tiles and stakes. But birch brush, the U. S. Bureau of Fisheries found, provides the best anchorage of all.

Birch brush with its numerous branches provides abundant parking space. A single birch brush may become an apartment house for thousands of future oysters. It is lifted out of the water easily, too.

Within a few years the American coast will probably be lined with submarine forests of oysters.

Boy Scout Firemen Aid in Thrilling Rescues

ANY boy who longs to be a fire fighter and help in thrilling rescues can be one now—if he is a Boy Scout and if his city fire department has one of the

recently instituted Boy Scout Fire Auxiliaries.

Scouts in several cities are doing valuable work in aiding the regular fire departments in this way. Besides putting out brush fires, they turn in alarms, report fire hazards, and at big fires assist in holding back crowds, helping with the hose and cleaning up. The scout firemen are equipped with badges that permit them to go through fire lines. They report to the highest fire department official at the fire for orders, but are not allowed to enter a burning building or risk their lives.

The boys are organized into companies and have regular hose and ladder drills.



Boy scout fire auxiliary, Pasadena, Calif., learning to handle ladder and hose

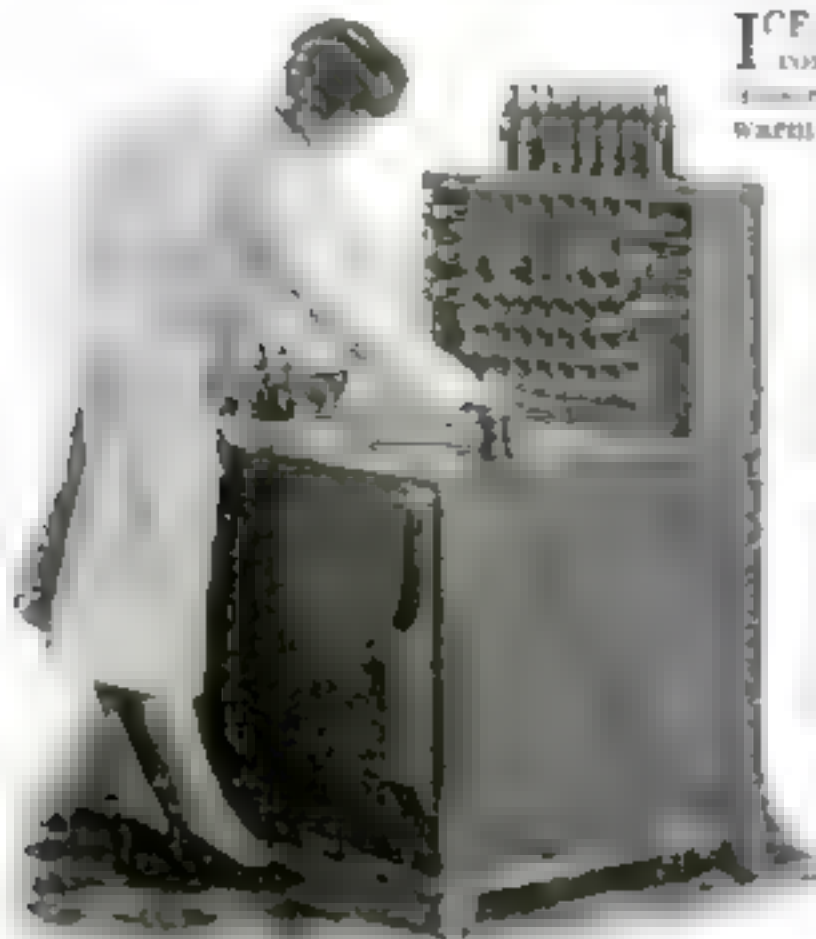


Soft-Drink Server Keeps Bottles Ice-Cold

IF COLD soft drinks at any time come out of the automatic server illustrated here. As you put in a warm bottle at the right end, you automatically push out an ice-cold bottle at the left end. The bottles travel through an ingenious arrangement of L-shaped tubes from one side of the cooler to the other. There are eight tubes for eight different flavors of drinks, each tube holding nine bottles.

The tubes pass through a cork-insulated chamber filled with ice. Since the cooling chamber is opened only for refilling two or three times weekly with ice, the ice, it is said, lasts considerably longer than in an ice box.

Soda fountains and way-side drink dispensers using this unique new drink server find it more sanitary than the usual type of ice box where the bottles come in direct contact with the ice. The bottles come out uniformly ice-cold, too, not sometimes lukewarm.



Putting a warm bottle at one end pushes out a cold bottle at the other, making it unnecessary to open the ice box

New Type of Violin Bow Plays All Strings at Once

ALl four strings of a violin, as well as three or two of them, can be played simultaneously with the strange bow illustrated at the right. The bow, invented by Herman Berkowski of Berlin, Germany, is flexible and bends almost in a semi-circle over the violin. As shown in the picture, the little finger of his right hand manipulates a lever which loosens or tightens bow strings while he is playing.

Many striking chord effects can be produced with this unusual bow.



This little finger adjusts the bow string

Magnet Separates Metal Scrap

BY MEANS of a magnetic device for separating iron and steel from non-metallics, the General Electric Company, Schenectady, N. Y., saves \$20,000 annually in disposal of scrap. A rheostat reduces the current to a point where the metal is picked up and the non-metal dropped.

The Predecessor of Your Saw



The stone is chipped to form sharp teeth

AS SURVIVAL of the Stone Age, when man killed game with spears or arrows tipped with flakes of flint, skinned his trophies with jagged bits of rock and sewed his fur garments with fish-bone needles, is found in this curious Maori stone saw made by a New Zealand native.

Blade and handle are shaped from stone, and the cutting edge is chipped to serve as teeth. It was from such beginnings as this that modern saws developed.

Hot Meals Delivered to Homes in England, Too

ENGLISH houses, yes, like their American sisters, are being relieved more and more of the duty of preparing meals by caterers who do the cooking for half the neighborhood.

A caterer in the town of Fitchley does such a flourishing business that he undertakes to deliver orders two hours after they are received.

He packs the soups, meats, vegetables and desserts in separate containers, which fit snugly one above another in a tall insulated can, as shown in the picture. They are still piping hot when delivered. More than 5,000 families in

this London suburb, it is said, have their meals sent home in this way.



Delivering hot meals to homes in Fitchley, England. The tall cans contain receptacles for soups, meats, vegetables and desserts

Odd-Shaped Tool on Key Ring Does Several Jobs

FIVE tools in five different places aren't half as useful as five tools in one place, always where you want them. The tool above combines a bottle opener, a wrench for one eighth inch to one half inch round or square parts, a screw driver, a presto key and a key ring, made of hard steel.

Camera Shows Errors in Acting

IN TEACHING stage technique at the Eastman School of Dramatic Action, Rochester, N. Y., the camera plays an important part. In this school the art of acting for the legitimate stage is taught in all its phases, each step of the training augmented by moving pictures made to show the student's errors and progress.

When the student first enters the freshman class, he must register, in front of the cine camera, certain assigned emotions. Later he sees himself on the screen, and the instructor points out methods for improvement. Every three months thereafter new films are made.

Several plays are staged for public performers during the school term, films being made of the entire action at rehearsals. These films serve as the basis for corrective criticism.

Make Maps Directly on Metal

CHARTS and maps are now being engraved in metal by a new method devised by the hydrographic office of the U. S. Navy Department. The process permits the engineer to compile charts or metal printing plates without the necessity of preparing a finished drawing.

Plywood Crates Save Padding the Furniture

MARRED, broken or scratched furniture sold at reduced prices at freight sales testify how hard it is to pack furniture so that it will ship safely. Ordinarily, large pieces are shipped in crates built of slats, making it necessary for the furniture to be wrapped and padded carefully.

A new shipping box has now been designed to overcome some of these objections. It is made of plywood. Single panels of this lightweight wood form the sides of the crate, covering the furniture completely and leaving no seams or cracks through which dust and rain may seep. Consequently no padding is necessary, and the packing men can do their job in considerably less time. According to its designer, the crate touches



Courtesy Allen Engineering Co.

There are no seams or cracks through which dust and rain might seep, and the same crate can be used several times.

the furniture in only two places—the back and bottom, both unfinished surfaces.



The right hand keeps striking the "type key" as the pointer is moved from letter to letter. The other key used is the word-spacing key.

Typewriter Has Only Two Keys

IN PLACE of the alphabetical keyboard of the ordinary typewriter, the new machine at the left operates by the simple means of moving a pointer with the left hand and pressing two keys with the right hand.

At the left of the machine is a plate showing the letters. The operator moves a pointer to the letter he wants, simultaneously striking the "type key" with his right hand. This single "type key" prints whatever letter the pointer points to. By rapidly shifting pointer from letter to letter, simultaneously striking the "type key," the typing is done. The other key used is the word-spacing key.

Three-Wheel Skate Has Rubber "Cushion" to Save Bumps

TURNING sharp corners on high is possible with the new type of roller skate shown below. It has only three wheels, a pair in front and a single one of smaller size under the heel. Answering the same purpose as shock absorbers on a car, there is a rubber cushion under the heel plate to take up the bumps of the road and to "cushion the driving force."

All three wheels are rubber tired and ball bearing, containing two rows of balls. They are of the steel disk type, the front wheels being four inches in diameter, the rear one less than three.

The novel cushion application is intended to make the new skates less tiring than the ordinary roller skates.



Rubber cushion under heel absorbs shocks.

Prongs Foil the Watch Thief

A SMALL but mighty enemy of the watch thief is this gold watch guard resembling an acorn, attached between the ring of the watch and the watch chain. A jerk on the chain brings out three prongs which catch in the pocket and prevent the watch from being pulled out easily.

Build Fences to Test Paint

FULLY \$2,000,000 is spent for paints every working day in the United States, according to the Engineering Foundation's committee on wood finishing research, of which A. H. Saben, of New York City, is chairman. Last year the nation spent \$600,000,000 for paint. And more than half the painting was done by nonprofessionals.

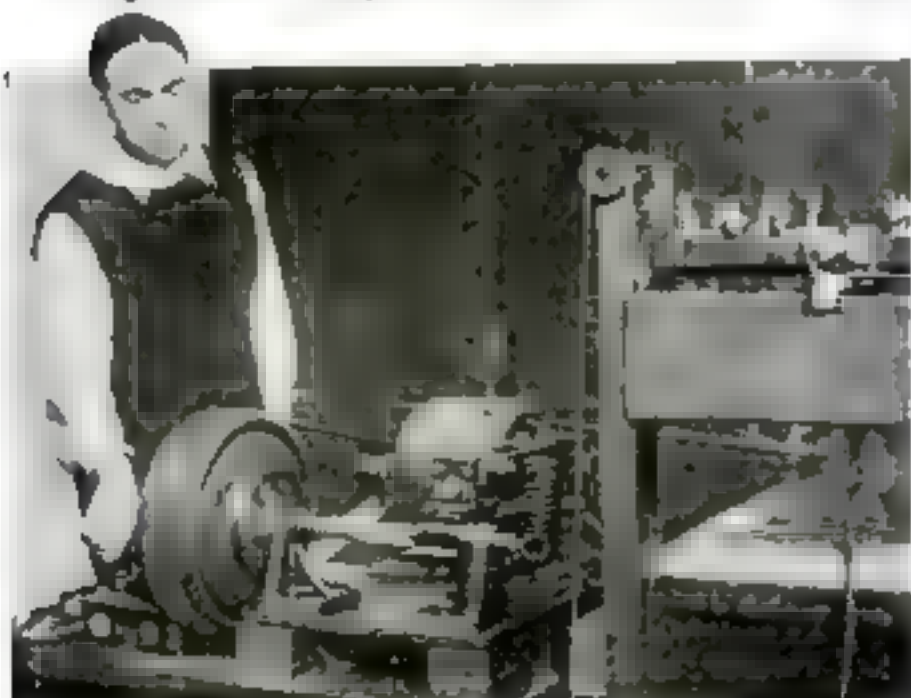
"Test fences" of sixteen different kinds of woods are now being erected in different parts of the country, to study the effects of paints and varnishes on them. Each fence has sixty-four panels, representing sixteen kinds of wood. The tests are being carried on by the Bureau of Standards of the Department of Commerce.

Such fences have been erected in Madison, Wis.; Fargo, N. D.; Milwaukee, Wis.; Palmerton, Pa.; Sayville, N. Y.; Washington, D. C.; Gainesville, Fla.; Grand Junction, Colo.; Tucson, Ariz.; Fresno, Calif.; and Seattle, Wash.

Move Ancient House 35 Miles

STICK by stick, a 200-year-old house was moved recently from Southbury, Conn., to Norton—a distance of thirty-five miles. Dr. and Mrs. L. T. Swift took a fancy to the house, engaged a builder to take it apart, move it, and reassemble it.

Spark Plug Tester "Treats 'Em Rough"



Hammering and compression machines reproduce the conditions of rough usage to which the average spark plug is subjected.

TO PROTECT

motorists from trouble due to weak spark plugs, the United States Bureau of Standards in Washington is giving spark plugs severe tests with an automatic vibrator. C. H. Roeder is shown here operating the testers.

The device at the left hammers the plugs several hundred blows a minute. Those that survive this are then tested by the machine at the right for leakage.



It's Easy to Pick Your Club from a Golf Bag Like This

OPENING down the long side, the new type of golf bag shown above completely exposes all the clubs, making selection of clubs easy. When the bag is closed it locks automatically. Rings hold the clubs in place so that they cannot slip out, no matter at what angle the bag is held. Each club is kept separate from the others and golf balls, too, may be carried in the bag.

In appearance the new bag is similar to ordinary types, the difference being a metal skeleton with special rings and clips for holding the balls and clubs.

Ingenious Violin Plays Itself

AFTER working on the problem for fifteen years, two French technicians, it is reported, recently completed the "Violonista," a device that imitates mechanically the playing of a violin. The machine uses a real violin and bow and can be synchronized with a player piano.



It circles its hanger five times a minute.

Ceiling Fan Swings Around in Circle

EVERY person and every corner in the room gets a bit of the breeze from the new rotating electric fan shown at the left. It is a ceiling type fan, mounted at a 45-degree angle, and is geared so that it rotates completely around its hanger, throwing breezes in all directions and cooling a circle twenty feet in diameter. The rate of rotation is about five times a minute.

Modern Magic Lamp Betrays Frauds

THROUGH the invention of a remarkable quartz lamp recently in Germany it is now possible to detect, quickly and easily, frauds not only in pearls and wool fabrics but also in stocks, bonds and paper money.

The new lamp utilizes the well-known power of ultra-violet rays to produce different tints and degrees of brightness in different materials. By this means it makes it possible to distinguish immediately between animal and mineral matter.

If you hold a pearl under the rays of this lamp, according to reports, it will betray instantly whether the pearl is real or synthetic. And if you want to determine whether a fabric is really all wool the lamp will instantly show whether cotton threads are present.

Under its rays, counterfeit stocks, bonds and paper money are detected easily, for the slightest difference in the composition of the paper shows in a difference of color under the ultra-violet light. It also reveals erasures or changes.

Old parchment manuscripts, long undecipherable, may now be read. Parchment is of animal origin, and the stylus and inks were mostly mineral. The chemical action resulting can be traced under ultra-violet rays, though the original writing may have been erased with pumice stone.



Joist Saw Has Double Blades

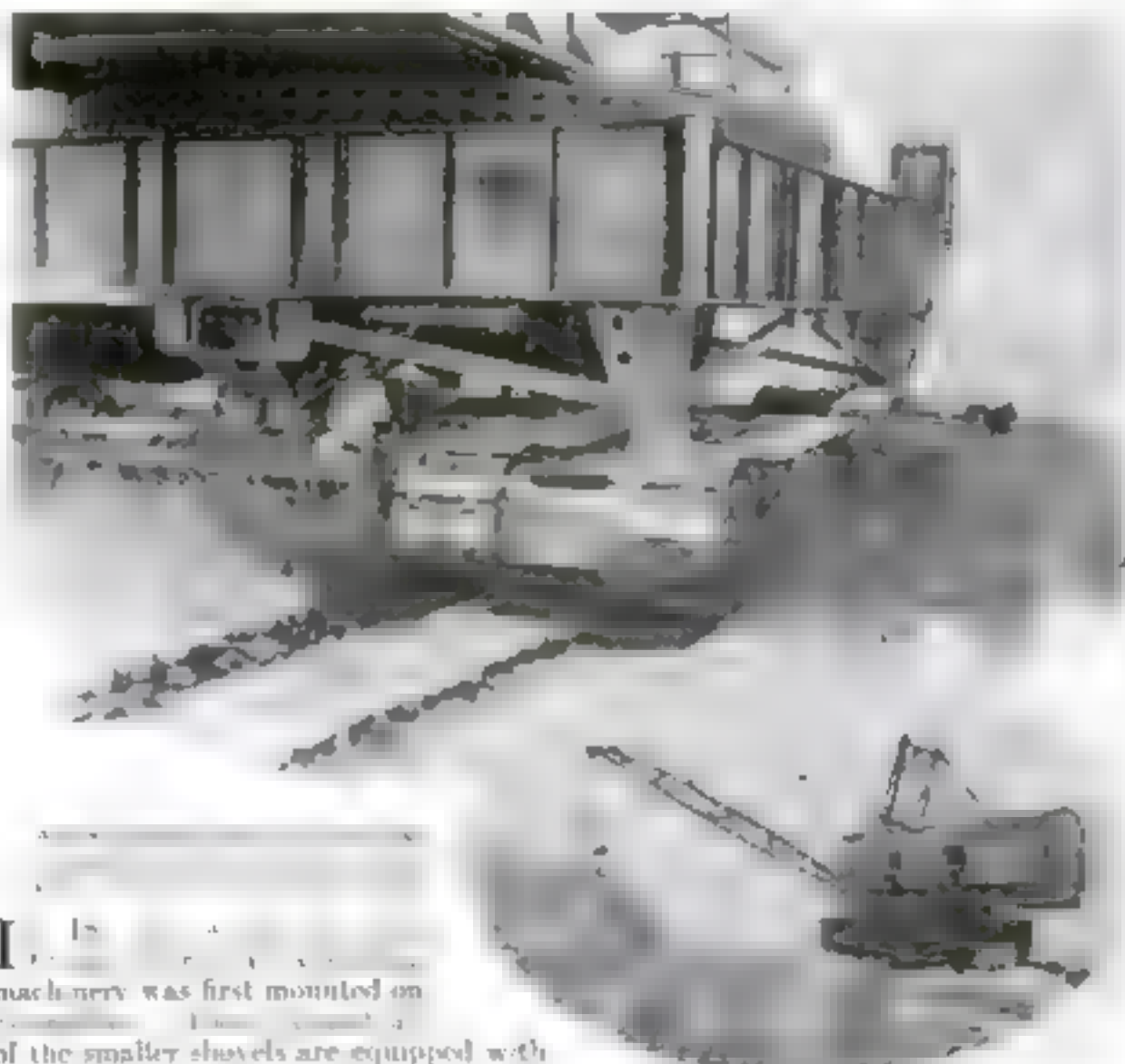
MAKING both cuts at the same time, to the same depth and in one operation, this new joist notcher is designed to save time and labor. The two saw blades are parallel, and the tool operates on the principle of a plane. Weighing only two pounds, it is easy to handle.

New Paint Resists Even Acid

ELATERITE, the substance forming the base of a remarkable new paint, is a hydro-carbon deposit found in commercial quantities only in Utah. It was only recently that a formula was found making this amazing product available in the form of paint.

Materials coated with it, whether wood, metal or concrete, are said to be proof against the destructive action of acid, alkali, water, oxygen and nitrogen. After the paint has been applied, the solvents evaporate, leaving a solid, completely poreless veneer.

500-Ton Excavator Rolls Easily on Caterpillars



In the construction of the machinery was first mounted on caterpillars. Some of the smaller shovels are equipped with this type of mounting, and the successful mounting recently of a 300-ton shovel indicates that it is just as practical for the giant machines.

In spite of its tremendous weight of a million pounds, this new machine prop-

pels itself across soft ground without difficulty. It is mounted on four units, each made up of two caterpillar belts a yard wide. It turns corners easily compared with truck-mounted machines.



Bike Races on Spinning Runways Thrill Amusement Parks

THRILLS and fun and lightning speed racing are in store for visitors to amusement parks where the brand new bicycle ride above just invented, is being installed. Sixty bicycles set on four mov-

ing runways speed on stationary steel platforms. The rider pedals his bicycle as he would on the street, but goes much faster, since at the same time the vehicles are spun around the circle by motors. Riders

can save those on other tracks, though of course the inner and shorter tracks have an advantage. This newest thriller has had safety tests and is said to be both fool-proof and accident-proof.

More Work for Safe-Crackers

SAFE-CRACKERS will have to apply their ingenuity to overcoming still another obstacle, if the concrete safe introduced in Paris becomes generally adopted.

This safe has an outer wall of solid concrete; consequently, it is said, there is no danger of demolition by fire or from the application of chemicals. It has a central core of steel, reinforced with a solid wiring of steel, and the concrete is placed around this material.

Protecting the Tunnel Autoist

CARBON monoxide, the poisonous constituent of automobile exhaust gases, presents a serious problem to the designers of vehicular tunnels. Where traffic will be heavy, as in the vehicular tunnels under the Hudson river at New York City, now nearing completion, special precautions must be taken.

A new apparatus now protects motorists by measuring the amount of the poisonous gas present in the tunnel. It is said to be the most sensitive instrument known for determining carbon monoxide, attaining the sensitivity of one part per million. It was devised by chemists of the Bureau of Mines.



Odd Camera Doesn't Need Films

INSTEAD of taking pictures on film, the novel camera above takes them on sensitized cards which give you finished pictures a few minutes after exposure. At the back of the camera is a light-proof sleeve through which you insert the cards. After exposure the card is put in a developing tank, which is part of the outfit. In a minute or two the card is removed and immersed in water and the picture is done.

New Idea for Battery Charging

A SIMPLE oxidized surface of copper could replace vacuum tubes, acid solutions, or mechanical vibrators in current rectifiers, which change alternating into direct current for charging storage batteries and operating radio sets, according to L. O. Grondahl, of New York.

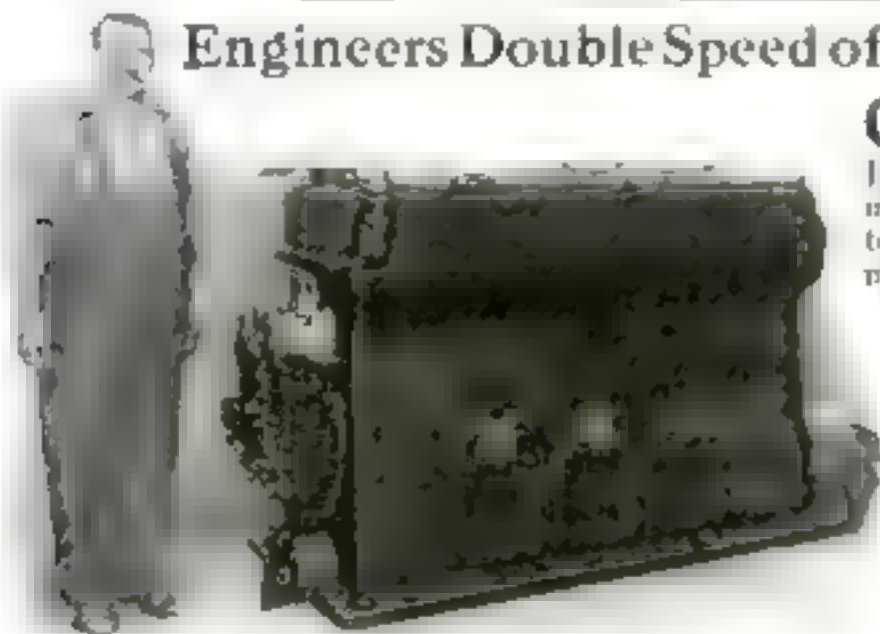
By subjecting metallic copper to high temperature, oxide of copper forms on its surface. Grondahl has found that this layer allows an electric current to pass through it in one direction only. If an alternating current is passed through, he says, it is changed into a current which flows only in one direction.

A Microscope for Everyday Use

FOR the amateur microscopist, the new pocket microscope illustrated below has several special advantages. The tube can be removed from the base and placed directly on the object to be examined, unlike the average microscope in which the object must usually be placed on a glass slide or card. A mirror ordinarily underneath the "stage" of the microscope may be placed above it when the base is removed, to throw reflected light down on the object.

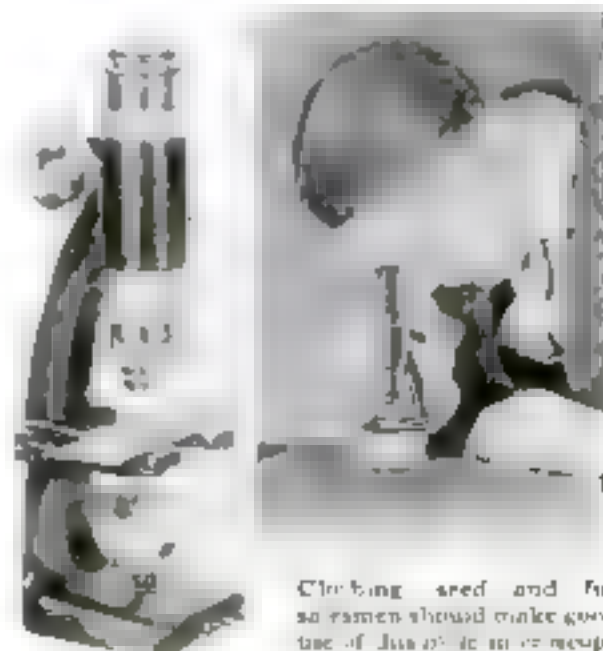
Though inexpensive, the new instrument has a wide range of magnification.

Engineers Double Speed of Diesel Engine



Looking at it from the outside, you mightn't know this was a Diesel engine. The complete inclosure is a new feature of each apparatus.

OPENING new fields of application for Diesel engines, the new machine at the left is said to be the only one on the market of its kind especially adapted for power wheels, cranes, industrial locomotives and so on. Its speed range is approximately double that of others, while its weight has been reduced proportionately even more. It is also novel in being completely inclosed and in being lubricated automatically.



Clipping seed and fur so rarer should make good use of this as it is a microscope.

Radio Set Built in a Baby Grand Cabinet



IT LOOKS like what it isn't. This deceptive piece of furniture shown at the left. A casual glance at it would tell you that it was a tiny baby grand piano. But it produces harp, clarinet and bango music as well as piano—in fact, any music that happens to be broadcast when you tune in. On occasion, it is even a "talking piano," when the radio program schedules speakers. This unique radio cabinet contains a six-tube tuned radio-frequency unit, home built with cone loudspeaker. The top of the piano acts as a sounding board.



Keeps Swimmer & Smokes Dry

WHEN it is a risk to leave cigarettes or money on the beach, swimmers can now carry these into the water with them, in the special waterproof case shown above. There is a holder in the case for cigarettes and matches, but when money or jewelry is to be carried the cigarette holder is removed. The case is made with a rubber piece fitting snugly in the top, and is fastened to the swimmer's wrist.

Build Huge Dam in Maryland

MUSCLE SHOALS will take third place in water power capacity when a tremendous development on the Susquehanna river in Maryland for the Philadelphia Electric Power Company is completed. The station will develop 3,000,000 horsepower, 90,000 more than Muscle Shoals.

A dam 4,800 feet long will be built across the river, making a lake covering 8,100 acres which will completely submerge the little town of Camargo, Maryland. Seven enormous water wheel electric generators will generate electricity which will be sent over a 220,000-volt transmission line to Philadelphia.

Pressed flowers mounted on cards for botanical study are more durable if subjected to a treatment devised by F. M. Woodruff, curator, Chicago Academy of Sciences. Dipping in transparent liquid solution produces a permanent coating.

Rope Shot Out by New Gun Aids Sinking Ships

IF THE seas are too heavy to lower lifeboats, rescues are often made by shooting life lines from the deck of the vessel standing by. A new type of line-throwing gun, small and compact, made to be shot from the shoulder like a rifle, was used recently in a spectacular rescue of sailors off the coast of England. As shown at the right, the line is contained in a cylinder at the end of the gun barrel.



A shot thrown out the lifeline toward the sinking ship, uncoiling its full length despite winds.

Distresses of bees, fishes and plants caused by protozoa may be banished, it is said, by oxygen apparatus under pressure.

How Much Do YOU Know about Science?

THE following ten questions, each relating to some fundamental fact of science, were selected from hundreds sent in by readers. How many of them can you answer? Turn to page 163 for the correct answers.

1. What is the so-called "second wind" of the athlete?
2. What muscles are used when you sneeze?
3. Why do we see small details that do not appear in a photographic picture of the same subject?
4. Why do some kinds of wood float while other kinds sink?
5. When can you see a rifle bullet while it is traveling through the air?
6. Why do some radio loudspeakers distort the music?
7. Why do nickel-plated surfaces sometimes rust?
8. Why does it take a long time to boil an egg on the top of a high mountain?
9. Why is a gas stove flame blue while a gas burner gives a bright yellow light?
10. Why is a differential gear needed in the rear axle of an automobile?

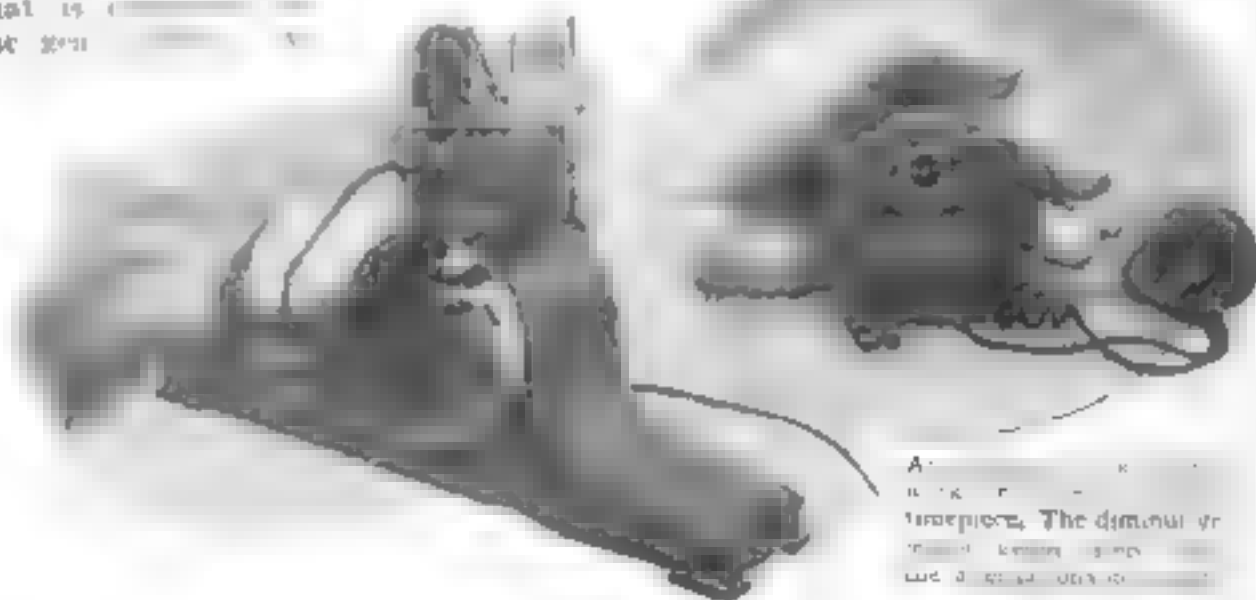
Novel Electric Clock Runs on New Principle

THE remarkable new electric clock shown below has no key because it never needs winding. It is simply connected to a light socket or wall plug. The current must be of the alternating type, as the clock will not run on direct current.

While electric clocks are not new, this one operates on an entirely new principle. It is not controlled by a master clock at the central power station, as such clocks have been up to now. This is a small clock that is connected to the power line.

The illustration shows, it looks much like the audio transformers used in radio receivers to amplify sound. Actually it is a tiny synchronous motor that always keeps in step with the alternations in the electric current.

Modern power plants regulate the frequency of the alternating current so exactly that the clock is said to run for weeks or even months with only a few seconds error.



A novel electric clock. The diagram of the clock shows the transformer-like appearance of the clock.



Shows Where Your Money Goes

TAKING care of the pennies will take care of the dollars, the old copybooks advised. A pocket hookkeeper like the one shown above will tell you where the nickels and dimes go, too.

A ruled paper strip winds around a cylinder, and can be moved forward or reversed. The strip is ruled for date, item, amount received, paid, and balance.

His Barbed Wire Fences Relay Radio to Neighbors

BARBED wire fences can carry radio concerts as well as any other kind of wire. So a young farmer, Perry Brown, who lives in western Kansas, connected his receiving set to a barbed wire fence nearby and now entertains farmers for miles around. Similar connected fences stretch in all directions enclosing his land, and neighbors who want to hear the radio concerts have only to tap the wire. The dry cedar posts used in the fences modulate the radio current from the ground as it travels along.

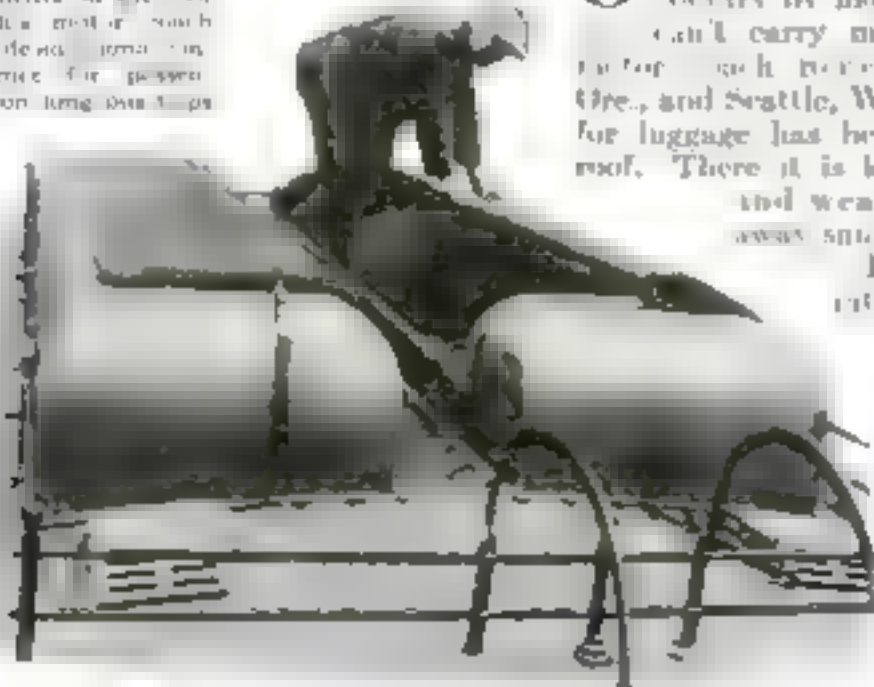
Gramophone Has No Tone Arm

A NEEDLE, a cone and a record are all that is needed to make a gramophone, according to a recent invention of a professor of physics at Sydney University, Australia. No sound chamber, no arm for the needle, and no reproducer are necessary in its construction, it is reported. The cone is made of a special kind of Australian wood that acts as a resonator and is attached directly to the needle.

LIVE ELECTRIC wires strung through the trees are the latest means for fighting the destructive sucking moths that infest the orchards and rose gardens of the Northwest, keeping off the pests with an operating time as brief as five minutes a day.

Motor Bus Stores Passengers' Baggage on Roof

Built-in baggage compartments on the roof of a motor bus can hold a large amount of baggage, and are convenient for passengers on long bus trips.



Pest-Trapping Cage Covers the Whole Tree

IN ITS fight against pest that destroy our fruit trees, the United States Department of Agriculture is trapping them in wire cages, as shown at the right, big enough to fit over a full-grown tree. Latest trees attacked by the cages are sprayed with different kinds of material to determine the percentage of insects killed by them. The insects fall on canvas covering the ground in the enclosure and are plenty and plenty.

The cage is made in sections, and can be easily moved from one tree to another.



Catching the insects in the cage, then using the material to determine the percentage of insects killed by them.



Doctors to Learn by Movies

NEW discoveries in medicine, difficult and unfamiliar operations and so on, are to be made into movie films so that physicians all over the country may study them, according to a plan of New York City medical authorities.

These films will form a "medical library" and will be shown in a series of lectures. The films will be just as deliberately as they were, they will be able to see how certain new operations are performed.

Tennis Handball—A New Game

FROM Europe comes a new game, something like tennis, something like handball, but actually neither. A light ball is used, and the player catches it in a net hung between two handles, as shown above. The handles are hinged and when they are closed the net tautens and the ball is flung into the air.

The game is played with a court net as in tennis, scoring points each time the ball is missed.

KNOW YOUR CAR

WHILE the modern lacquer-type auto finishes are extremely durable, one substance in common use will seriously damage them. That substance is alcohol.

You can spill alcohol over the hood when you are putting in your water supply and little damage will result if you have an ordinary paint and varnish finish, but spilling alcohol on the new lacquer finish is sure to leave marks that cannot be eradicated by careful washing.

While the new methods of covering the surface of your automobile give you a finish that is durable, your car can be kept attractive much longer if you take care of it. Follow these simple rules:

1. Dust your car frequently and carefully.
2. Always use clean, soft rags for dusting.
3. Wipe off the rain drops with a clean piece of chamois after you have been out in the rain.
4. Polish the car after you have dusted it, using a piece of old silk cloth.
5. If you want to use a liquid polish, buy only the kind recommended by the manufacturer of the particular material used in finishing your car.

Movie Camera Runs Itself While You Act in the Picture



A famous actress—like her—may use this new camera.



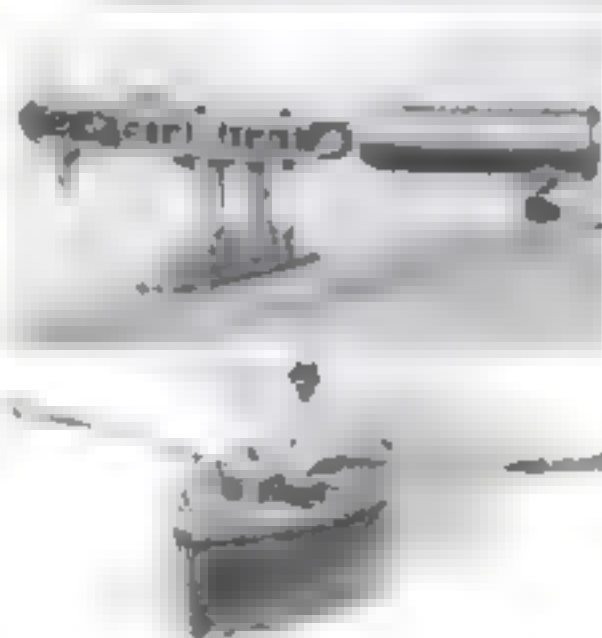
AS EASILY as you make snapshots, you can make movies with this newly developed motion picture camera that weighs only five pounds. Run by a spring motor and loaded with 100 feet of film, it records more than four minutes of action.

It has a fixed focus, so no focusing manipulation is needed. Pressing a lever starts taking the pictures. There are two finders, one for making pictures at eye level and another when the camera is held waist high.

Not only can you make movies with this new camera, but you can act in them yourself. To do this you must set it on a tripod, start the motor, walk the picture and take part in the action! The same film that was used in the camera is also used in projecting the pictures on the screen. A new amateur projector will screen these films with an image of thirty by forty inches at a distance of eighteen feet.

Double Value from Gas Heat

MUCH of the heat wasted in gas cooking need not be lost but can be saved and used again, according to the inventor of an ingenious device made for this purpose. Excess heat from burners in the front of the stove is conducted to the back of the stove and used under other utensils. There is usually a surprising amount of such excess heat under cooking utensils, says the inventor.



Rowing in the direction you are facing is quite easy with these ingenious oarlocks. A bolt prevents slipping and the device can be adapted easily to your old oars.

You Face Ahead When Rowing with These Oarlocks

WITH your rowboat equipped with the curious oarlocks shown at the left, you can face the bow of your boat and look ahead in the direction in which you are rowing. There is no danger of the oars slipping from the locks, as they are fastened by a bolt.

Another unusual feature of this device, invented by Fernando Lopez Cervera, of Mexico City, is that the oars can be folded and turned inside the boat when not in use. They can also be shortened or lengthened by adjusting a bolt in the shell which holds them.

Your old oars can be adapted easily to these attachments. They measure eleven inches in length when folded, and weigh about seven pounds each—light enough to carry. They can be detached from the boat simply by removing a bolt.

Do Your Weeding Standing Up

WEEDING and back-aches go together, any gardener will tell you that. But that's if you stoop over and pull the weeds by hand in the good old-fashioned way. A new way is to use a weeder that you work with your foot. The one illustrated has a curved iron cleft at the end, about six inches long, riveted to a long wooden handle.

The curved iron fits around the root of the weed and lifts it up. The tool is used like a spade, your foot pressing on a steel brace.



The tool fits around the root of the weed.

Road Garden Slows Up Cars at Grade Crossing

NOTHING could be simpler than the plan pictured below to force motorists to slow down at dangerous grade crossings. Right in the center of the road, on either side of the railroad track, is a half-circle garden. To get around this and through the narrower "neck" of road, the

motorist has to watch out and slow down—thus saving himself from danger, whether he is on guard or not.

Heavy highway guards have been placed at this point, too, to prevent possible skidding into the tracks when the surface of the road is wet and slippery.

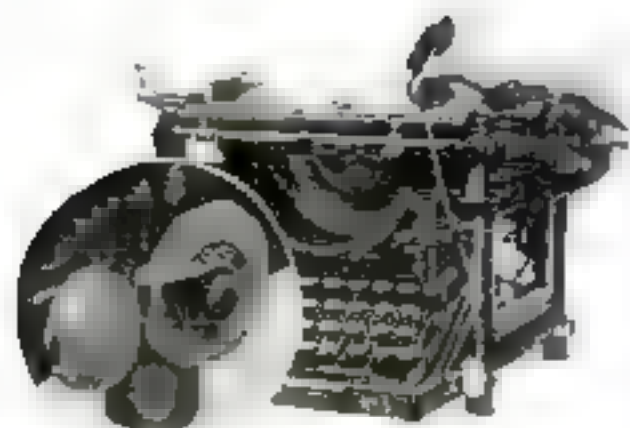


A new idea to guard motorists at dangerous railroad crossings—a semicircular garden right in the center of the road, forcing motorists to slow up and drive around it.

A Fascinating New Game

YOU can look forward to a lot of fun and fascinating competition playing the best game of the year to be introduced in next month's issue.

This game is an entirely new discovery. It is as captivating as cross-words and as scientific as chess. There'll be cash prizes for the best players, too.



Ties Eraser to Your Typewriter

THIS new device automatically keeps the typist's eraser always in the most convenient place. A tough and durable cord attaches the eraser to a spring-operated reel inside a small metal drum fastened to the typewriter frame. When the eraser is released after use, the reel pulls it back to a position convenient to the right hand. The eraser itself can be of any duck type.

Pocket-Size Balloon Gives Short and Thrilling Rides

SMALL enough to be fitted into a satchel is the strange balloon invented by Norman Meadowcroft, aircraft engineer, of Hammondsport, N. Y. It weighs only ninety-nine pounds when fully equipped, but gives short air rides.

When filled with gas, the rubberized fabric bag is about twenty-one feet in diameter. The carrying device for the pilot is supported by ropes attached to the bag. A horizontal propeller is mounted so that it may be turned and maneuvered by pulling on the ropes.

The balloon has ascended as high as 640 feet, and has remained in the air for two and a half hours, the inventor says.

As a German mechanical engineer who has been in this country only two years, I wish to say that *POPULAR SCIENCE MONTHLY* is the best magazine I have ever read, and I hope I shall never be without it.—W. G. E. P., Hudson, N. Y.

Hot Steel Roller Removes Snow by Melting It

MELTING snow may prove the quickest and most economical way of removing it from city streets. The new

"snow converter" shown below, it is said, will remove snow and ice from streets at a cost of 20 cents a cubic yard as compared with \$1.65, the present cost.

A seven-foot roller of half-inch steel attached to the front of a motor truck is heated internally by oil burners and fueled under pressure from a supply tank mounted on the truck. It maintains a terrific degree of heat. The roller can be raised to melt snow piles and drifts as well as the even fall on the streets.

The roller travels through the streets at a speed of three miles an hour, melting snow as it goes.



A new sight in some of our big cities this winter will be these sizzling "melters," crawling their way through the streets after a heavy snowstorm.

Has Your Town an Automatic Grocery Store?



PRESS a button, and the potatoes and sugar you want are delivered to your door! Her morning marketing is just that easy for the housewife who lives in Inglewood, Calif., where novel automatic grocery stores have been set up on leading street corners.

The shopper looks at the goods displayed in permanent show cases and

punches a button underneath what she wants. An order card comes out, she writes her name and address on it and drops it into a slot. The goods are delivered to her home from a central warehouse.

As shown in the pantograph, a practically complete line of groceries is offered, for only samples, taking up little space, are displayed.



It works like an automatic atomizer. You don't pump or pump, but simply plug into an electric outlet and aim the gun.

A New Weapon to Fight Bugs

HERE is a new weapon to help you fight insect pests in your home—or factory. It is an electric spraying tank, illustrated at the left. Sufficient force is generated to throw a fine spray of disinfecting liquid a considerable distance, to the ceiling or inaccessible corners.

The disinfecting liquid is contained in a tank, as shown in the picture, and a motor drives the blower. In effect, it is an automatic atomizer. If desired, the tank can be removed and the machine used as a dust blower.

Straddles Plants in Cultivating

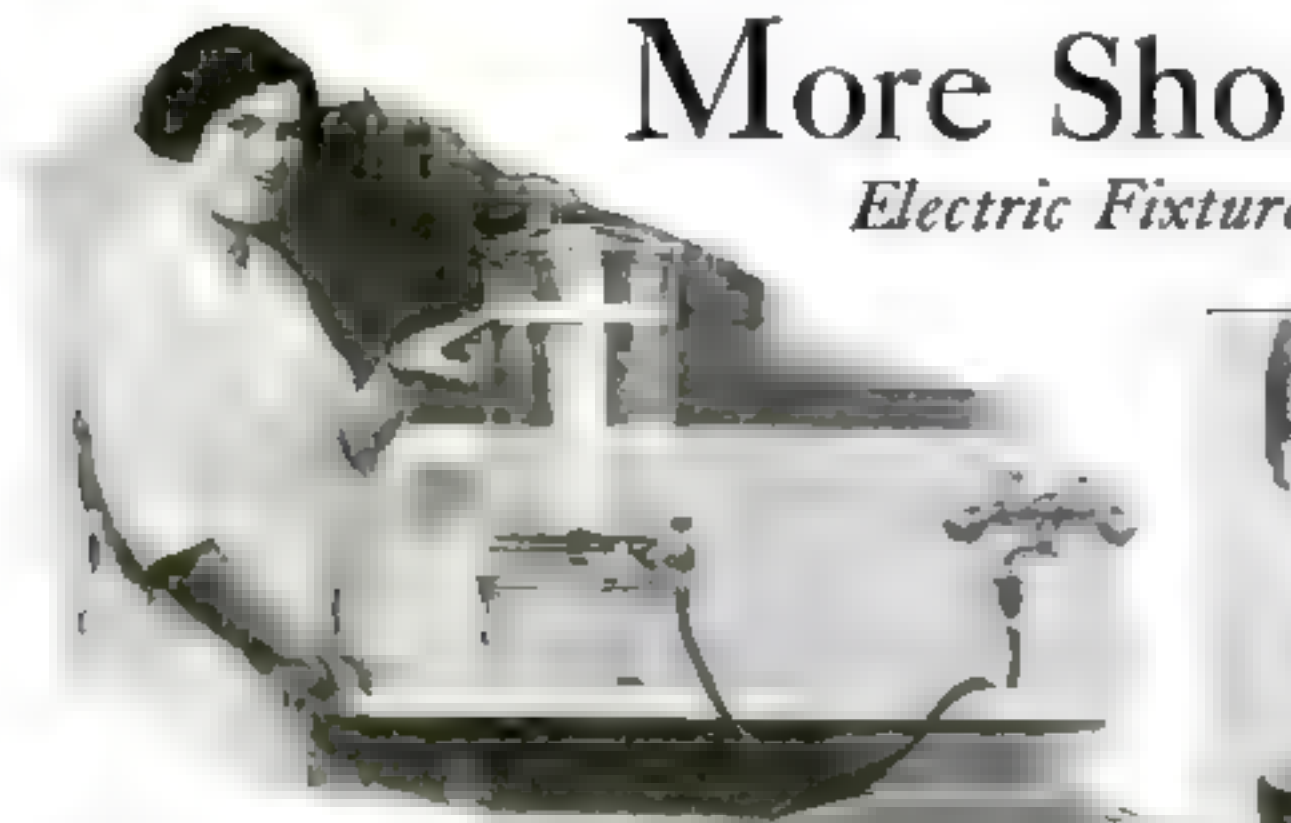
ONE trip down a row of onions, beans or corn with this new hand cultivator will complete the cultivation in half the time required by the single-wheel plow, says its inventor, Captain C. C. Hall, of Williams-



town, W. Va. It straddles rows of plants of any width up to seventeen inches, and up to eighteen inches high. One of the handles and plow frames can be removed, if desired, leaving a complete single plow. Or the positions of the plow frames can be reversed, making a between-rows cultivator. The plants may be cultivated very close without injury from the wheels.

More Short-Cuts *for*

Electric Fixtures That Aren't Fixed,



Purified Water by Electricity

Of all the processes of purifying water—filtration, distillation, boiling, and so on—the newest is the hydroelectric process, illustrated in the household water purifier shown above. This device plugs into your electric circuit, and is said to remove all sewage, trade waste, undesirable tastes and other contamination from your water supply.



Grapefruit Corer Saves the Juice

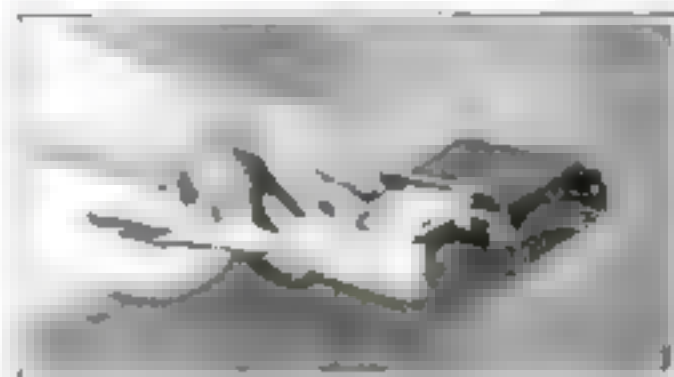
When the knobs of this grapefruit corer are down, a sharp-edged scoop fits in perfect contact with the inner wall of the tube, leaving the full opening. When the knobs are raised, the sharp edge of the scoop crosses the lower inside diameter of the tube, shearing off the bottom of the grapefruit core and pressing out all the juice.

Shoe Polish Like a Shaving Stick

A new kind of shoe polish (above) comes in handy stick form like shaving soap. It is said to be odorless, and, according to the maker, will not soil your hands. The polish is specially designed to make shoes waterproof and to preserve the leather. Its novel form makes it convenient to carry in the pocket.

The "Vac" Now Waxes Floors

The vacuum cleaner at the left, if you notice, is not "sweeping" a carpet but polishing a waxed floor. A new polishing attachment, easily admitted, fits the vacuum cleaner nozzle and is operated by the same motor. Since the secret of fine floors is a little wax frequently applied, this latest accomplishment of the "vac" will be welcomed.

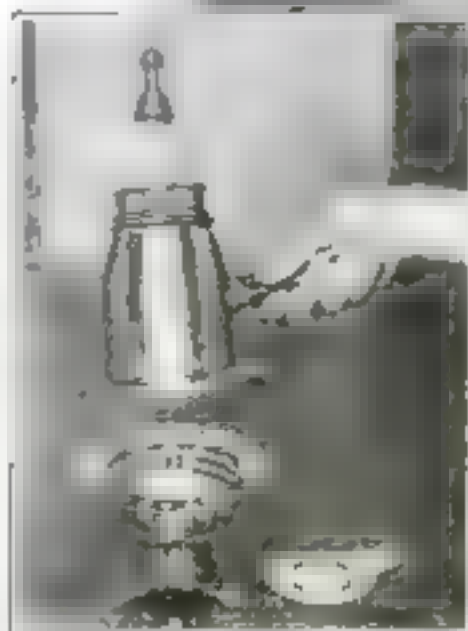


Tooth Paste Server Fastens to Wall

Even Johnny won't waste the tooth paste if he can squeeze it out of the server shown above. Turning a key delivers the correct amount of paste. The tube winds around a roller and is compressed between the broad blades. New tubes are inserted easily. The device can be used for shaving cream, too.

Gravity Times This Egg Boiler

An automatic timing device, operated by gravity, which keeps eggs boiling just as long as you set it for is a feature of the novel egg boiler above. It fits over the kettle and pulls the eggs up when they are done. The egg rack is attached to a weight that runs the time mechanism.



Warms Baby's Milk Wherever You Go

Where gas or electricity isn't available or convenient, warming baby's milk may be accomplished on the specially designed "canned heat" milk warmer shown at the right. The bottle fits in a container and the container is placed over the alcohol flame. It will come in handy when traveling and on picnics.

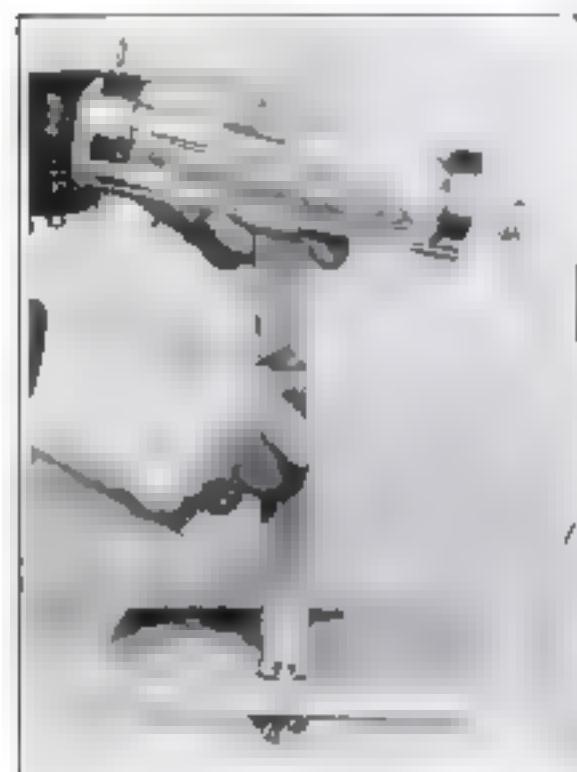
Electric Light Fixtures That Aren't "Fixed"

Plugging in your electric light fixtures as you would attach a toaster or iron is possible with a new base for fixtures (right). The fixtures can thus be removed for changing the furniture around—or when you move, you can take your lighting fixtures with you. The electrical connection is made with the standard plug. A special construction behind the outlet in the wall gives firm support to the fixture.



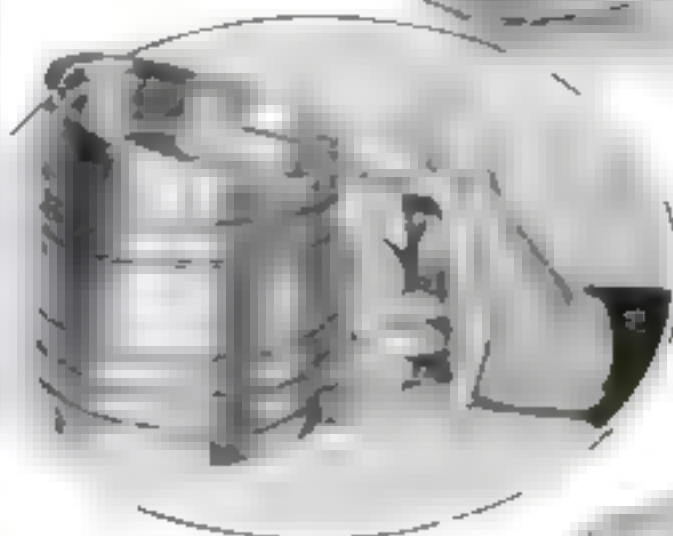
Efficient Housekeepers

New Table Stove and Other Helps



Supports the Bottle in Feeding Baby

The new nursing bottle holder at the left makes it unnecessary to hold the bottle yourself to the baby's mouth every time he is fed. Made of metal, it is easily attached, at any angle, to the tray of a high chair or to a baby carriage.



Pancakes or Waffles—Both from One Stove

Waffles today, pancakes tomorrow—both can be made on the same combination electric stove and right at the breakfast table, too. One side of the reversible plates is in waffle iron form, the other side smooth, as shown above. Or the plates can be removed entirely, leaving hot plates to use for frying eggs or cooking coffee.

Rubber Holder Saves the Soap

A saver of soap is the rubber bath sponge below, which holds either a whole cake of soap or small pieces. The sponge is fastened shut by slipping a bone button through slots in its rubber tips. It is good for massaging, too, the soap oozing out through perforations.



Squeezing the Handle Sifts the Flour

Squeezing the handle of the one-handed flour sifter above agitates the screen within and sifts the flour, making it possible to stir batter in the mixing bowl with the other hand.



Guards Hand in Bottling

To ease the bottle breaks while you are bottling catsup or grape juice, this capper above protects your hand. The protector is the circular metal piece above the cap.

Tea Ball That Works Like Scissors

You can make a cup of tea more quickly with the scissors-like tea ball shown at the right. It springs shut, and having a long handle, can be stirred about in the pot until the tea is the right strength. It holds enough tea for several cups.



Cloth Jelly Strainer Fits on Any Kettle

In jelly making season, this straining outfit left prevents many a scald and helps in making clear jellies. Two straining cloths fit in a metal frame, one inside the other. These may be washed easily. The frame is adjustable so that it may fit on the rim of any ordinary size of kettle, and collapses so that it takes up very little room in the cupboard.



Hooked Blade Peels Oranges

We'll all eat more oranges, now that a peeler has been invented (left) to make the job of skinning them less messy. The orange is scored around a little hook on the end of the blade is inserted, and the skin is neatly ripped down.

Press the Top—Out Comes a Pin

Press the top of the box at the right, and out comes a pin—head first too. It is a convenient accessory for the dressing table, as well as for the sewing room or the office desk. Picking up a pin from a dozen others in a tray often prickles the finger, and extracting them from a paper of pins is tedious. This ingenious box offers a new solution.



Distance—Tone—Volume—in A Powerful New Five-Tube Set

Easily Built Receiver Uses the Latest Types of Audio Tubes with Remarkable Economy—How to Make It

By ALFRED P. LANE



Tested and Approved by the Institute of Standards

This model five-tube receiver passed the tests of the Popular Science Institute of Standards with a very high rating. During the actual working test in the Radio Laboratory, the receiver drew only 15 milliamperes of current from the B-battery when used with the new 171 type power tube, or 8 mls when tubes such as the UX113 or 34u6 were placed in the last socket. You get maximum life from B-batteries with this receiver.

You Can Build It Easily

Fig. 1. A standard type of cabinet, standard panels and plain brass brackets form the framework and the arrangement allows plenty of room for any standard parts approved by the Institute.

arrangement of the instruments except to make special brackets for the balancing condenser *H* and inductance switch *I*.

The complete details of this method of subpanel mounting and support, together with a large-sized picture wiring diagram, are given in blueprints Nos. 54 and 55, listed on page 92. You will find these blueprints a great help in building a set exactly like the model receiver.

The circuit of the new set consists of one stage of radio-frequency amplification, a regenerative detector, and a stage of transformer-coupled audio-frequency amplification followed by two stages of resistance-coupled audio amplification. It is arranged for the use of any of the latest types of power tubes in the last audio amplifying stage, and a choke and by-pass are included to improve the quality by preventing any flow of direct current through the loudspeaker. This eliminates any chance of demagnetizing the loudspeaker or burning out the windings.

NO INTERSTAGE jacks are included in the circuit because best results always are obtained by operating the loudspeaker on the power tube in the last stage with the volume regulated to suit by rheostat *T*.

All five tubes are controlled by self-adjusting rheostats with a hand operated rheostat in series with the self-adjusting rheostat connected to the radio-frequency amplifier tube. By turning this rheostat *T* you can cut the broadcast music or speech from full volume down to complete silence without affecting the quality. Incidentally, this method of filament control makes it possible for any member of the family to operate the receiver, since there is no possibility of damaging the tubes by burning them too brightly.

HERE is a modern five-tube radio receiver, easily built, that combines to the highest degree the qualities you want most. It is remarkably sensitive to weak signals. Tuning is almost knife-like in sharpness—as sharp, in fact, as is possible without causing distortion. The volume is tremendous, and the quality of the reproduction is practically perfect. All musical notes, from the lowest to the highest, come out of the loudspeaker with clear, lifelike fidelity.

Combined with these advantages is another feature of great importance to the radio fan who does not possess a B-battery eliminator. This new POPULAR SCIENCE five-tube receiver is extraordinarily economical of B-battery current even when used with the latest and most powerful types of audio amplifying tubes.

The Popular Science Institute of Standards has carefully tested and approved the model receiver. The figures for B-battery current consumption given elsewhere in this article were determined during the official tests.

The design incorporates several novel features that will make it particularly easy for you to build this receiver. The subpanel is made by cutting $\frac{5}{8}$ of an inch from the end of a standard 7 by 24 inch front panel. Simple brass right-angle

brackets are used to attach the subpanel to the front panel, and the weight of the subpanel plus the instruments mounted on it is supported at the ends by wooden strips nailed to the inside of the cabinet and by the binding post panel at the back. And should you prefer to use a wooden baseboard instead of a composition subpanel, no change need be made in the

Ask Us!

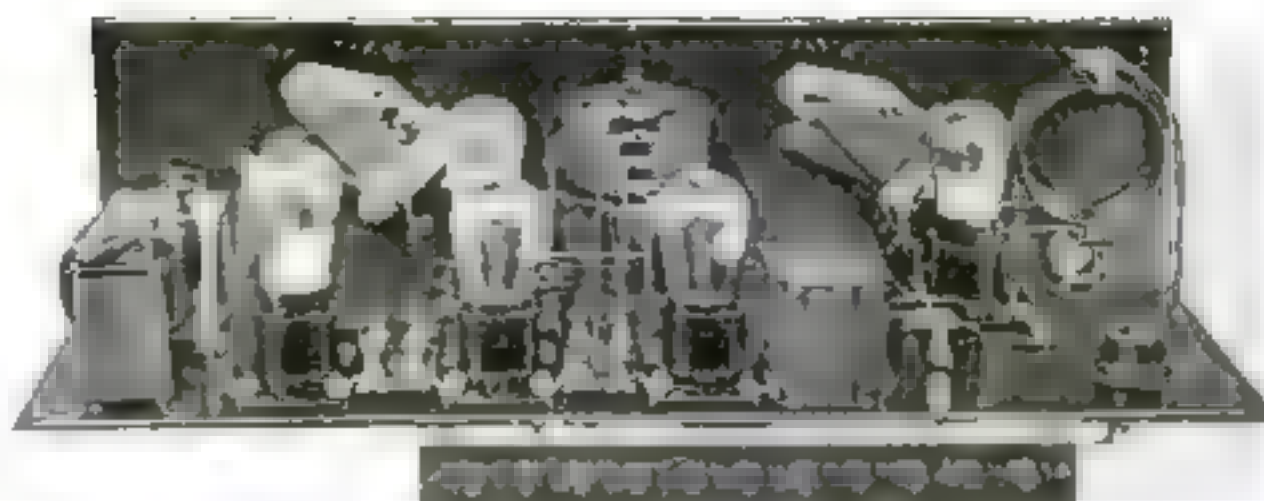
SEND for the list of radio apparatus approved by the Popular Science Institute of Standards. It will help you to choose parts that will enable you to build a satisfactory radio receiver.

Remember also, that blueprints Nos. 54 and 55 listed on page 92 will prove a great help.

We want you to make a success of building this powerful new set. If any points do not seem clear or you want any special information about the proper parts to use, we will be glad to answer all questions without charge. Please make your letters as detailed and specific as possible and address them Radio Editor Popular Science Monthly, 250 Fourth Avenue, New York City.

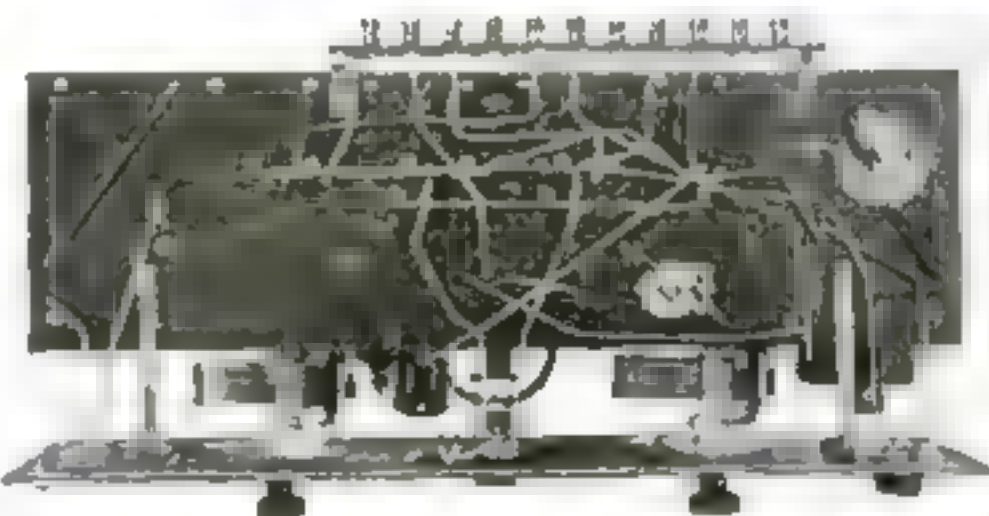
The receiver is designed for use with an outdoor antenna of from thirty to 150 feet, and it will give excellent results with a short indoor antenna. The tapped antenna coil and inductance switch *H* will make it possible to adjust the set for the best possible combination of distance-getting ability with selectivity depending on local radio reception conditions and the length of the antenna. Here are the parts you will need for the construction of the receiver:

- A* and *B*—radio-frequency tuning unit.
- C*, *D* and *E*—detector tuning unit.
- F*—radio-frequency choke coil.
- G*1 and *G*2—variable condensers, .0005 mfd.
- H*—adjustable variable balancing condenser.
- J*1—grid condenser .00025 mfd. with clips for grid leak.
- J*2—tickler by-pass condenser .0005 mfd.
- J*3—C battery by-pass condenser .01 mfd.
- J*4—audio by-pass condenser 2 to 4 mfd.
- K*—audio transformer.
- L*—audio-frequency blocking choke.
- M*1, *M*2, *M*3, *M*4 and *M*5—vacuum tube sockets.
- N*1 and *N*2—resistance-coupling mountings.
- R*1—grid leak 2 to 8 megohms.
- R*2, *R*3, *R*4 and *R*5—coupling and leak resistances 1 megohm (100,000 ohms).
- S*1, *S*2, *S*3 and *S*4—self-adjusting rheostats size 1A.
- S*5—self-adjusting rheostat size 112.
- T*—20 ohm rheostat.
- U*—open-circuit jack.
- V*—filament switch.
- W*—resistance switch.
- X*1 and *X*2—standard composition panels 7 by 24 by $\frac{3}{8}$ inches.
- Y*—binding post panel $1\frac{1}{2}$ by 12 inches.
- Eleven binding posts, two vernier



The Subpanel Hides the Wiring

Fig. 2 (above) and Fig. 3 (left) show you how to drill all the holes for the wires before you bolt the instruments to the subpanel. All wires under the subpanel are spaghetti covered, while those above are bare. You can use a wooden baseboard in stead of the subpanel without changing the general arrangement.



dials, two knobs, strip brass $\frac{1}{8}$ by $\frac{1}{4}$ inches, bus wire, spaghetti, screws and nuts.

All of the parts used in the receiver are of standard construction and can be obtained from any dealer in radio supplies. The design of the set allows plenty of room for parts of almost any make on the market.

Most radio fans will prefer to buy the tuning units *A*, *B* and *C*, *D*, *E* already wound and mounted, but for the benefit of those radio fans who wish to wind their own coils, here are the specifications. Coil *A* is wound with 15 turns of No. 24 single silk-covered wire tapped at the

fourth and eighth turns. Coil *B* has 80 turns of No. 22 single silk-covered wire wound spaced so that there are twenty-nine turns to the inch. You can get this spacing by winding a piece of No. 8 cotton thread in the coil as a spacer. Coil *C* is wound with twenty-four turns of No. 20 single silk-covered wire wound without spacing and tapped at the center. Coil *D* is just like *B*, while tickler coil *E* is wound with thirty turns of No. 24 single silk-covered wire wound without spacing.

Coils *B* and *D* are 3 inches in diameter. Coils *A* and *C* are $2\frac{1}{2}$ inches in diameter. Coil *E* is $1\frac{1}{4}$ inches in diameter.

Several types of radio-frequency choke coils are now on the market that are suitable for use at *F*. You can wind this choke coil yourself if you prefer. Wind about 600 turns of No. 32 cotton or silk insulated wire on an ordinary thread spool. Do not wind the wire in smooth layers. It should be jumble-wound or, in other words, criss-crossed back and forth.

THE variable condensers *G*1 and *G*2 are of the modern straight-line frequency type.

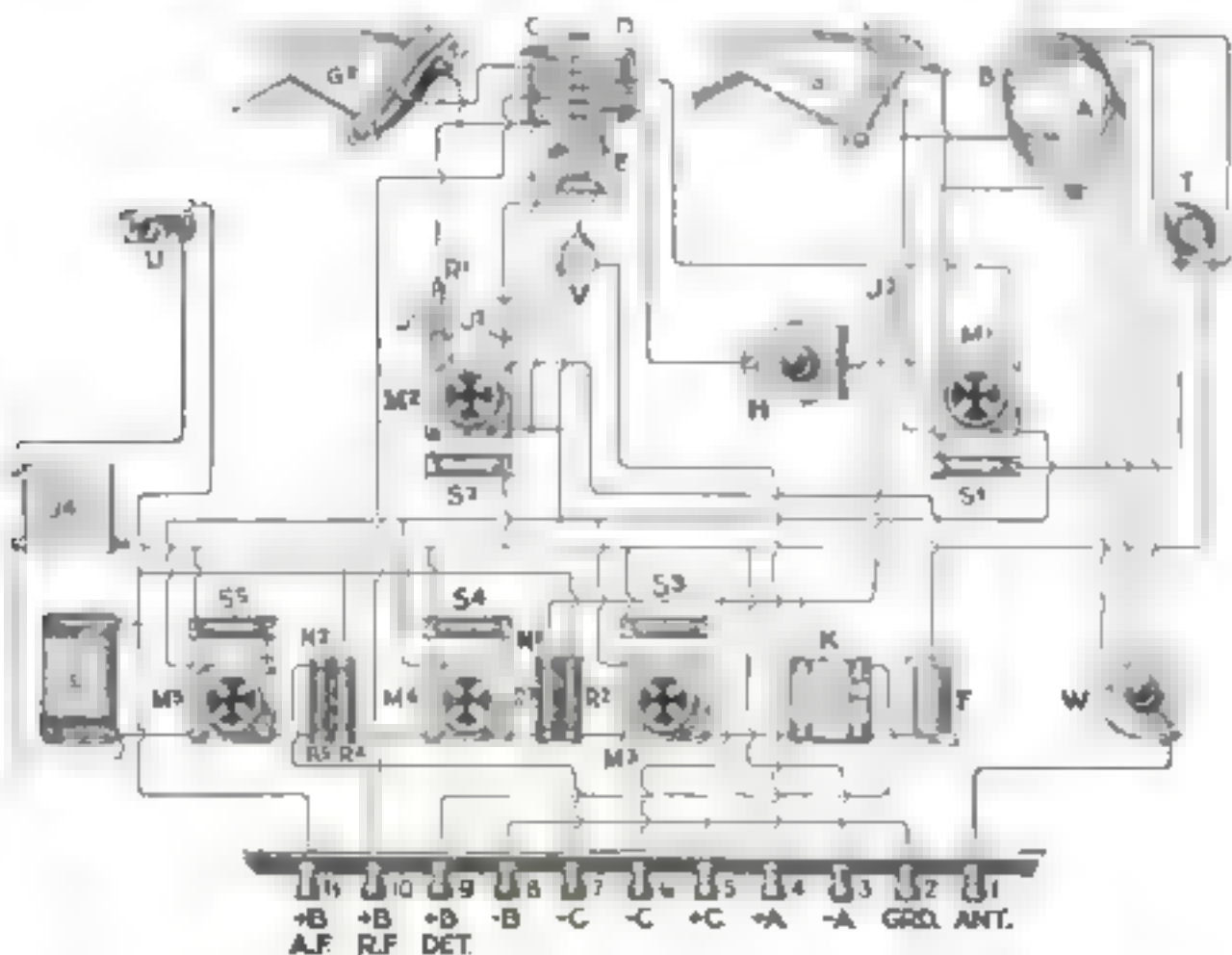
Use a high grade audio transformer at *K*. The quality of the reproduction depends on a high grade transformer at this point in the circuit.

Several styles of choke coils suitable for use at *L* are now on the market.

The audio by-pass condenser *J*4 should be not less than 2 mfd. for best quality. A 4 mfd. condenser was used in the model receiver so that there would be no doubt on this point. *N*1 and *N*2, the resistance-coupling mountings, are of standard type, consisting of a coupling condenser and clips for mounting the coupling resistance and leaks *R*2, *R*3, *R*4 and *R*5.

Your dealer will be glad to help select parts suitable for use in building this receiver. You will save time if you take a copy of the magazine along with you.

Many radio fans live where the buying of radio parts is not a simple matter, and if you have diffi- (Continued on page 152)



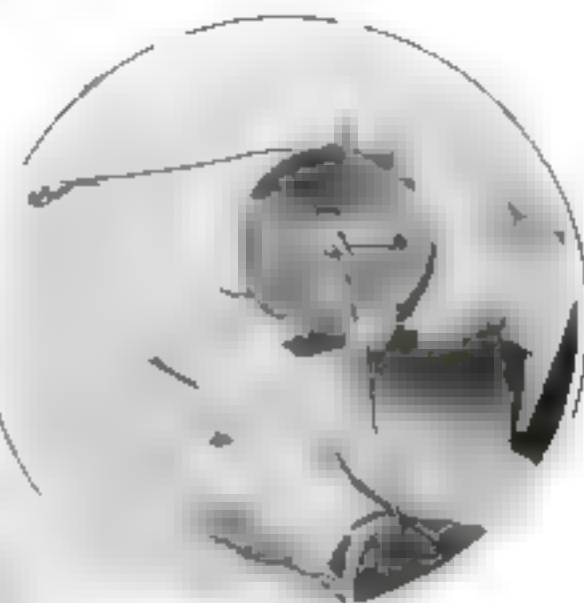
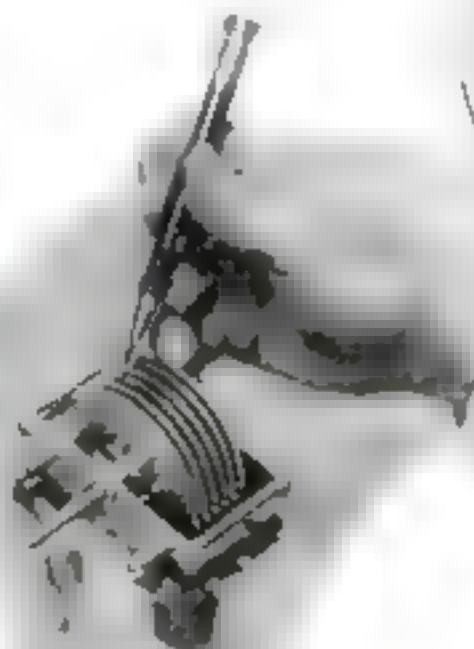
Follow This Picture Diagram When You Do the Wiring

Fig. 4. When the picture wiring diagram shows one wire connecting to another, you are to make the connection to the nearest point on the wire. Make every connection as short as possible.

Radio Novelties *on Land and Sea*

Condenser with Novel Plates

At first glance this new condenser, below, looks just like the older models built to give straight-line capacity effects. The plates, however, are made of heavy cast aluminum tapered so that the capacity of the condenser increases rapidly to give the desired straight-line frequency tuning effect.



This Antenna Reels Up

For use with portable radio receivers or as an antenna wherever it is not possible to put up a permanent installation, this reel antenna, above, will prove useful. It consists of a copper strip that winds around a drum inside a metal case. A plug makes the connection to the set.

Portable Antenna Takes Parasol Form

Twelve metal loops are set into a metal bracket mounted on the end of a wooden pole. In the queer antenna above, each loop of wire is linked to increase the actual amount of wire at each loop. This new antenna is said to be remarkably efficient.

Why Not Wire Your House for Radio, Too?

A house recently built on Staten Island, N. Y., was wired for radio as well as for electric lights. Wall switches in every room permit the switching of programs from room to room or to have every loudspeaker in the house going at once. One master set is connected to the wiring, and there are additional sets in several rooms.



Vacuum Tube Muffled

Instead of the usual solid composition base ordinarily found on modern vacuum tubes, the one above has a base divided into two sections with a rubber pad between, and the prongs are connected by light wire. It eliminates ringing and audio feedback noises.

New Radio Ship Goes on the Air—and Water

The new cable cruiser MU-1 is fitted with broadcasting equipment of the most modern type. It will be used to relay reports of marine sporting events on short waves to station WAHQ, where they will be re-transmitted on a wave in the standard broadcast band. Right, Douglas Rigney, owner of the cruiser, before the microphone of the transmitter.



This Tube Is Almost a Complete Set

David L. Lucwe, of Berlin, has arrived in this country with a marvelous new radio tube (above) performing three functions at once. It is at once a detector, a stage of audio and a stage of power amplification. Adding a tuning coil completes the set.



How to Cut Floor Maintenance Costs

BEAUTIFUL floors, so essential to a pleasing interior, now are easily had through the Johnson Wax treatment. Quickly, inexpensively, with no hard work, this cleans, sanitates and polishes at one easy operation. It is ideal for every floor!

Wood, linoleum, tile, marble or composition floors—whether varnished, shellacked, waxed or painted—are lightly filmed with Johnson's Wax. Then the Electric Polisher is guided over them. You will be amazed at the wonderful improvement—and at the speed of it! Like magic this Electric Floor Polisher creates a gleaming, deep-burnished lustre which glorifies, protects and preserves the original finish.

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For \$2.00 a day you can rent a Johnson Electric Floor Polisher from your Neighborhood Store or from your Painter. Telephone NOW and make an appointment to rent this labor-saving machine for a day. Or, purchase one outright for your own exclusive use. The investment is small for so great a convenience. Your local merchant can supply you—or we will send one express prepaid.

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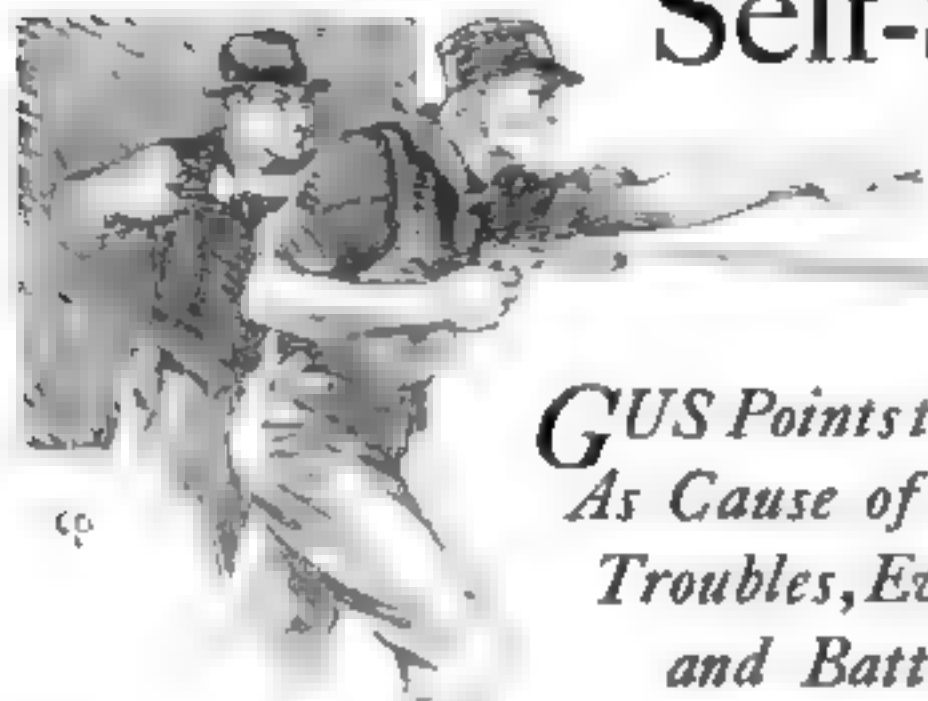
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Don't *Be Too Quick to Blame Your Self-Starter*



*GUS Points to Bad Connections
As Cause of Many Starting
Troubles, Even When Motor
and Battery are Good*

By

MARTIN BUNN

"IT'S funny how we seem to have runs first on one kind of work and then on another," observed Joe Clark to Gus Wilson as the two partners prepared to close the Model Garage for the night. "Right now it seems to be all electrical troubles," agreed Gus.

"Here's another one. I'll bet two cents!" Joe muttered under his breath as a shiny, new car pulled up in front.

The driver of the car looked as though he had been doing strenuous work.

"The self-starter is on the blink. Can you fix it?" he called out. "I had to crank it by hand to get down here. I can't see why it should go bad all of a sudden. It worked fine up to now."

Gus didn't ask any questions. He climbed in behind the wheel and, after testing the lights and noting that they seemed to be working at full brilliance, stepped on the self-starter pedal. There was a clank as the starter motor gear engaged with the teeth on the engine flywheel. The lights immediately went out, but the starter motor appeared to be too weak to spin the engine. Gus took his foot off the self-starter pedal, and the lights at once returned to full power.

"Humph!" he grunted. "I don't think there is anything the matter with the self-starter. The trouble probably is in the battery connections."

"That's it, all right," he continued after he had pulled up the floor boards and examined the clamps on the battery terminal lugs. "Look here! This one is loose."

It was so loose, in fact, that he was able to pull it off without touching a wrench to the clamping bolt. Joe handed him a piece of sandpaper, and Gus proceeded to give both the battery terminal and the clamp on the end of the cable a good polishing.

After he had bolted it firmly back in place, he removed the other terminal and gave it the same treatment. "And while we are about it," he observed, "I'm going to inspect the battery to make sure that it's getting enough charging."

When Gus had put the floor boards back in place, Burns, the owner of the car, stepped on the starter pedal, and the

starting motor spun the engine at a great rate.

"Gosh, that's fine!" exclaimed Burns. "It's simple enough when you know how, I suppose. Still, I don't see why the lights should work when the self-starter was dead as a doornail. I always thought that electric current either flowed if there was a circuit or didn't flow at all if the circuit was broken. I didn't know there were half-way points."

"That idea," Gus explained, "is responsible for a whole lot of electrical trouble on automobiles. Electric current going through a wire is a whole lot like water flowing through a pipe. It's a matter of pressure and volume. In the spark plug circuit you have thousands of volts pressure to shove a small volume of current through the resistance of a poor contact. Conditions in the starter motor circuit are just the other way around. The storage battery only develops a pressure of six volts, and yet you have to push as much as two hundred amperes through the windings of the starter motor to get power enough to start the engine when it is cold and stiff."

BURNS was interested. "I had no idea that the self-starter took so much current. That explains why they put in such a big cable to connect up the battery with the starter switch and motor."

"Right," Gus replied. "The big cable is absolutely necessary."

"Even when all the connections and the switch are in good condition, there is still a chance for trouble. If the brushes that make contact with the commutator of the starter motor get burned a bit, the extra resistance will cut down the current enough to make the self-starter sluggish and irregular."

"The queerest trouble I ever ran into," Gus continued, "wasn't due to anything wrong with the wiring or the brushes, although this self-starter certainly acted as though there was a poor connection somewhere. One time it would spin the motor just as it ought to, and the next time it would fail to work at all. I went over all the connections, cleaned the

switch and sandpapered the starter motor brushes. But it didn't help matters enough to notice."

I finally located the trouble under the frame of the self-starter motor. You know the current goes back to the battery by way of the frame of the car, and bolts holding the self-starter motor in place had worked loose. The car had been at the seashore for quite a while, and the dampness had caused rust. Some sandpaper cured the trouble."

"But why didn't the current get to the frame through the self-starter pinion and the gear on the flywheel?" asked Burns.

"Part of it must have gone that way," Gus replied. "But there isn't much chance for a lot of current to flow through the oily bearings of the crankshaft or the fabric linings of the clutch plates."

"And I suppose it couldn't get to the flywheel gear anyway on account of the oil on the pinion and gear," added Burns.

"You're wrong there," laughed Gus. "The Bendix type of starter gearing that is used on so many cars now is a peculiar piece of mechanism. It's the one moving part of the car that works better without oil. Don't ever oil it."

"A MAN who lives down the street here wouldn't believe me when I told him that, and he smeared a lot of cup grease all over the self-starter. It worked all right for a while, and then one chilly morning he stepped on the pedal and the starter motor hummed at a great rate without engaging with the flywheel. He tried again, and the engine started. Then it wouldn't disengage, and the strain busted three teeth out of the flywheel gear. He believes me now."

"Light oil wouldn't gum up like that when it got cold," suggested Burns. "Why not use that?"

"Don't do it," Gus insisted. "Even light oil is bad because it picks up dust and dirt, and after a while the starter gets all gummed up."

"Well, it's a relief to know that there's at least one part on the car that will work best if I neglect it!" laughed Burns as he stepped on the self-starter.

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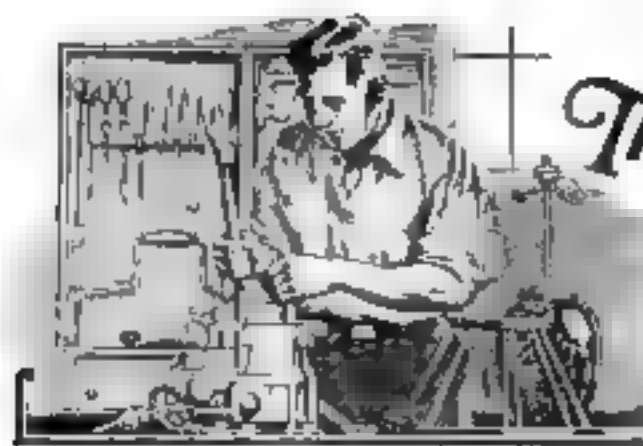
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The

Home Workshop

Arthur Wakeling, Editor

A Beautiful Clipper Ship for You

How to Build a Greatly Simplified Model of the Famous "Sovereign of the Seas"

By CAPT. E. ARMITAGE McCANN

THAT the majority of those who desire to make a ship model should prefer a clipper, is entirely understandable. It is the most beautiful of all ships. The extreme clipper ships were America's very own. They were first, and best, made here. They swiftly carried America's flag and commerce to the far parts of the earth and made many of the early fortunes upon which the prosperity of this country is established.

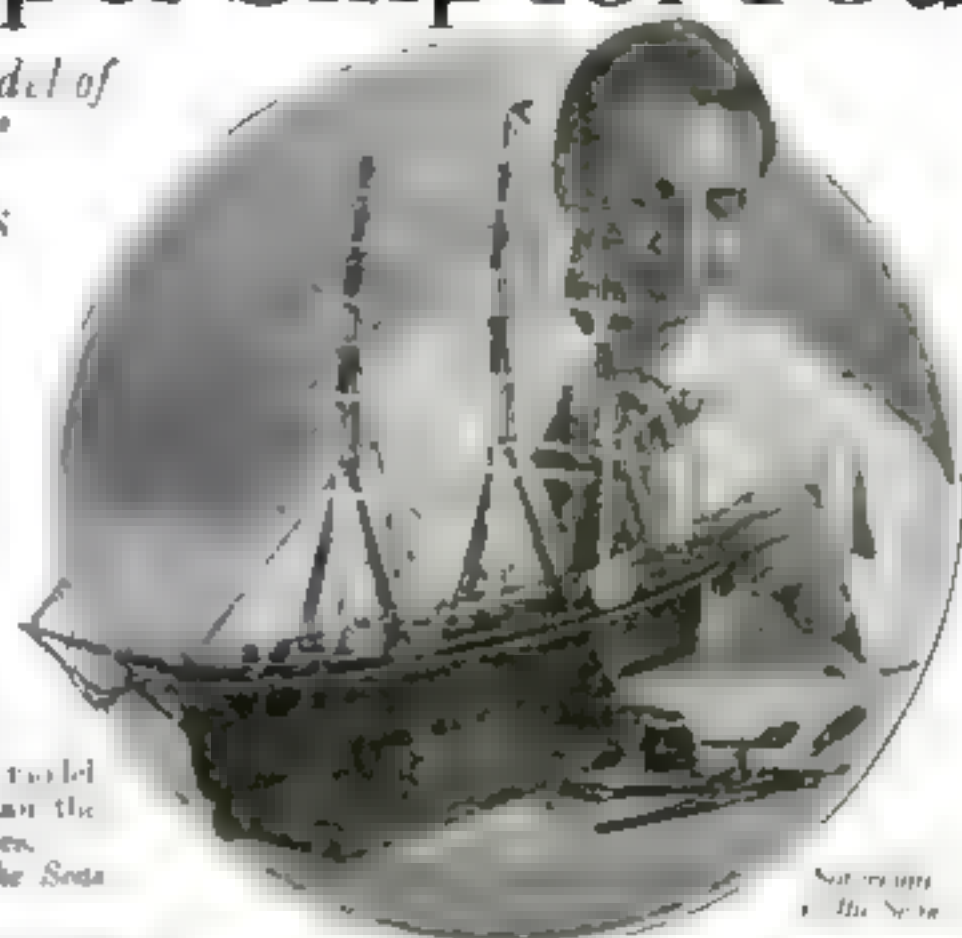
Although evolved entirely for utilitarian purposes, to combine speed with carrying capacity, they had a dignified grace not elsewhere found. Every line of their hulls was a graceful curve, their spars and rigging formed a delicate and beautiful tracery. Taken together, these elements combine to make a carefully built clipper ship model an unsurpassable decoration.

The writer has long hesitated in giving instructions to the uninitiated for the making of such a model because, being familiar with that type of ship, he is well aware of the almost infinity of careful work which can, and should, be put into an accurate and complete scale model.

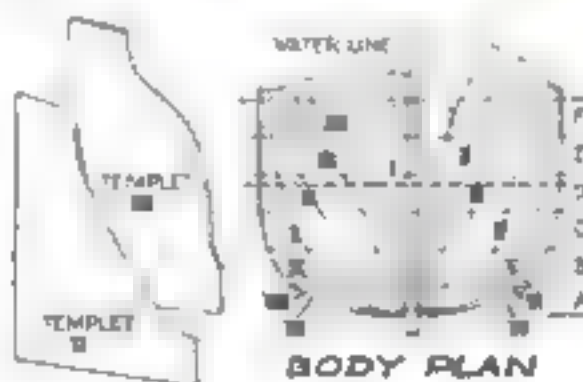
The demand, however, has been so insistent that he has worked out an easy

system by which, in hours instead of months, an accurate hull may be fashioned. He has simplified the fittings and rigging as far as he dared. Though much has been omitted, what is retained is reasonably correct and to scale. The result of following the instructions and drawings should be a model very much better than the great majority one sees.

The Sovereign of the Seas



Sovereign of the Seas



has been chosen, as one of Donald McKay's finest and fastest clipper ships. She was launched in June, 1852, and was the largest merchant vessel then afloat. Her tonnage was 2421 tons, deck length 208 ft. she carried 12,000 sq. ft. of canvas, and had a crew of 105 men and boys.

On her first voyage to San Francisco she was dismasted, but made the passage in 103 days. On (Continued on page 80)

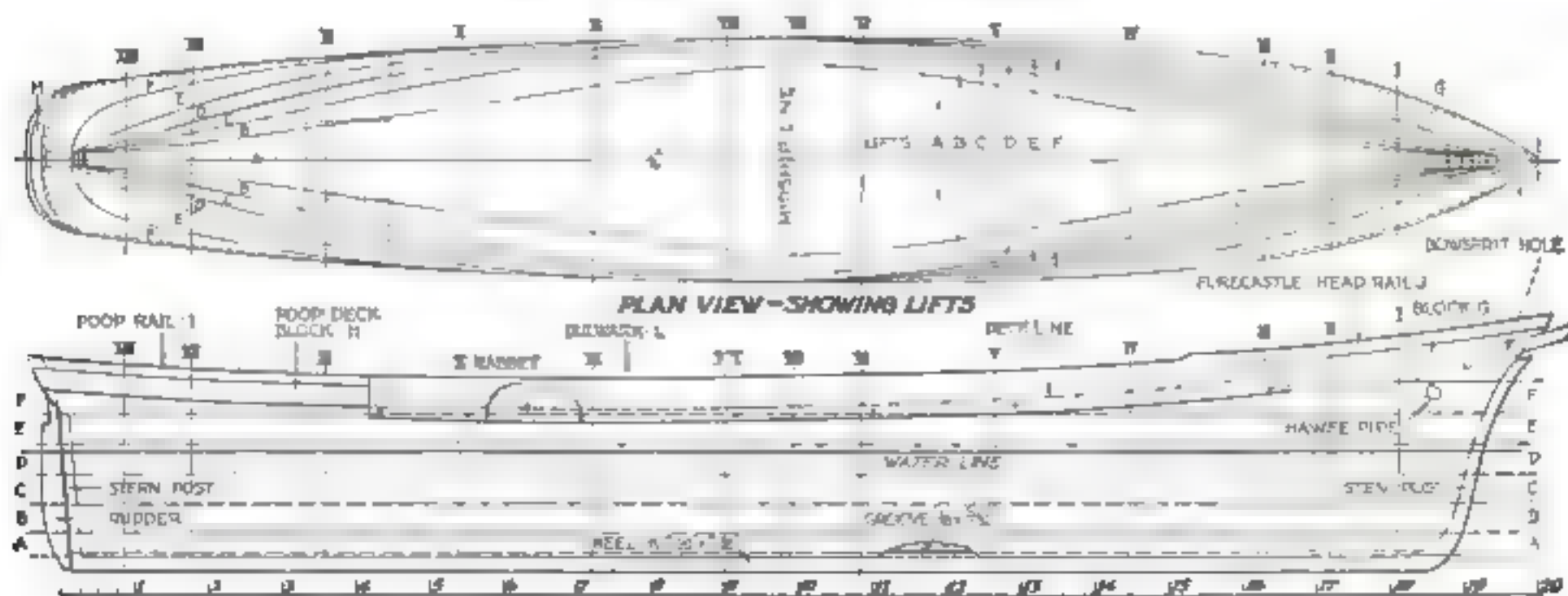


Fig. 1 The hull of the model exactly one-third full size. A complete set of full-size drawings—hull, rigging and details—can be obtained by

sending 75 cents to the Blueprint Service Department of Popular Science Monthly for Blueprints Nos. 51, 52 and 53. (See page 92)

Stenciling Is Easy to Do

*How to Enrich the Appearance of Painted Walls
with Borders of Beauty and Distinction*

By BERTON ELLIOT

Painting and Decorating Expert

MRS. McAllister and Mrs. Andrews were standing on the porch after the regular meeting of the neighborhood ladies' card club, when I arrived home early one midsummer afternoon.

"Good evening," said Mrs. McAllister. "We're glad you came. We want you to tell us just how you did those stenciled borders."

"Yes," chirped Mrs. Andrews, "ever since you showed us your stippled wall decoration, we have wanted to know more about stenciling and the use of stencils."

"Well, ladies," I replied, "if you have a half hour to spare, I'd tell you about it."

"Stenciling is really very simple. In fact, you'd be surprised how simple it is. To anyone who has never done this work, it is inconceivable that anything which adds so much to the appearance of a room can be accomplished so simply."

"I've got one of the stencils right here (Fig. 2). You see there's a guide hole at each end—or in other words the little cut-outs at the extreme ends of the pattern are exact duplicates. When one section of the design has been stenciled on the wall, the stencil is moved along so that the guide hole at the left end of stencil fits right over the stenciled spot on the wall at the extreme right of the pattern. The stencil is moved along length after length and always joins perfectly."

I went on to explain and demonstrate the method in detail. The substance of what I said was as follows:

All of one color is done around the room. Then on a two-color design the other part of the stencil is used, and the second color put in clear around the room. There are guide holes on the second color part of the stencil which fit over certain parts of the first color part of the border on the wall. Some stencils are in more than two colors, and the same principle is used in getting the correct register of pattern and colors.

STENCILING is done with a brush like that shown in Fig. 3. The stencil is placed against the wall, care being taken to have it parallel with the ceiling. This may be regulated by cutting off the top of the stencil so that the top edge will follow the ceiling or the picture molding and allow the design to fall whatever

distance is desired from the ceiling.

In some instances, as in bathroom or kitchen, the stencil is placed just above the wainscoting or chair rail, in which case the bottom of the stencil would have to be trimmed to be parallel with the guide-line it must follow.

The brush is dipped into the color—a little of which has been poured onto a



Fig. 1. Mr. Elliot demonstrates the application of a border stencil. Another color will be added to the design by means of a second stencil applied over the first one.

plate, and then is pounced onto the wall with a rotary motion. As in Fig. 1 the brush is held at right angles to the wall.

Either opaque or transparent colors may be used. The soft tinted effects are better accomplished with the transparent material, while the opaque materials must be used where the border design is to be lighter than the background. Otherwise it is largely a matter of individual preference and the particular effect desired.

Regular stencil colors are sold in tubes by most stores, these generally being of the transparent type (easily changed to opaque by the addition of flat wall paint). Regular flat wall paint in colors, or in white tinted with oil colors to the desired shade, are often used where opaque material is desired.

For thinning stencil colors to the desired consistency, turpentine may be used, but the glazing liquid which is used for glazed or stippled (Tiffany) effects, is preferable. When used it will be found that the paint does not pile up so much on the stencil, and also that the color will dry with a slight sheen which is very pleasing.

Do not, however, have the color too thin so it will run under the stencil, and always apply it with scant brushfuls. Another thing that must be done is to wipe the side that goes against the wall

after each setting, so that any color which gets over on the back of the stencil will not smudge the wall at the next setting. The stencil should be laid face down on a piece of paper and wiped off with a cloth, preferably moistened with gasoline or turpentine. Care is necessary or the cloth may catch and tear the stencil.

A FEW thumb tacks may be used to hold the stencil in place, if desired, especially until one becomes accustomed to using it. They will not injure the wall in the least if put in lightly and carefully withdrawn.

The stenciling should be started in the least conspicuous corner, and kept on around the room. With most stencil designs, the stencil may be bent to fit into the corners, always being careful not to break any of the delicate cut-out work. Some leave the corners until the last, which is all right if the space of the design each way from the corner is carefully measured off.

Frequently it is desirable to have the pattern come out even at a certain point. In this event, when you are about five or six lengths away from this point, find out what the discrepancy, if any, will be. Divide the odd space by the number of lengths remaining, and then "stencil" the necessary distance each length, extending the stencil for crowding it as required.

In designs of large figures, it is often necessary to determine the best placing of the figures before starting—so that a design, for instance, will come directly over a fireplace or over the center of a doorway. With such designs, it is better not to try to work around corners, but stop with the last full unit, and fill in the remaining space with some of the smaller figuration of the design, repeating if necessary. Care should be taken, of course, to have all of the corners look properly balanced.

"A STENCIL border certainly adds much to a room," exclaimed Mrs. Andrews, when I had finished. "How do you select the designs and colors that look so well?"

"That is a good deal the same as selecting becoming patterns and colors in anything—a dress, wall paper, or furnishings. It's a matter of good taste. Many paint manufacturers (Continued on page 100)



Fig. 2. A typical stencil such as may be obtained in any paint store; a stencil brush.

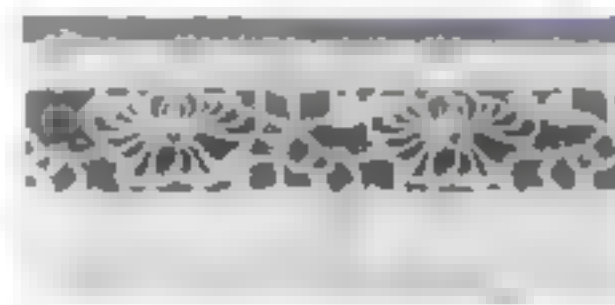


Fig. 3. A two-color border stencil applied to a wall already finished in sponge stippling.

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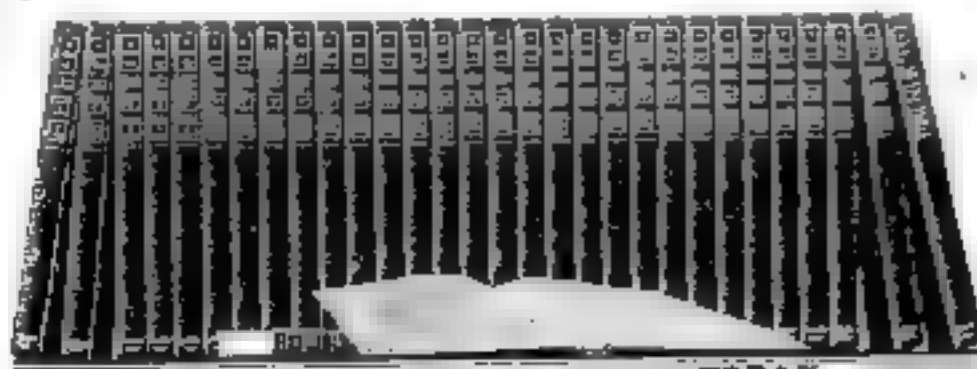
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Let's Hammer Out Some Bowls

It Is Surprisingly Easy to Do Decorative Work with Sheet Copper, and Little Equipment Is Needed Further Adventures in Toolcraft

By EDWARD THATCHER

BLACKSMITHS and smithing always have appealed to me. In my younger days I spent much time about a carriage shop in our neighborhood. I can still remember the pleasant smell of burning hickory as the blacksmith used a red-hot iron to burn holes for tire bolts.

One day I appropriated the family bellows, built a forge of old bricks, took some hard coal from the bin in the cellar, and lighted my first forge fire. My tongs were borrowed from the "fluting iron," a simple machine much used in those days to "flute" lace curtains. I remember the joy of it when my iron got really red hot and I made my first forging.

Seeing that I was determined to make things, my grandfather gave me a set of watchmaking tools. This was a great step forward and I still have some of these tools.

My attic shop lasted me through my public school days. As I grew older I took up bent or Venetian ironwork, which was then much in vogue. I remember making enough money—the first I ever earned in my shop—to buy one of the earliest phonographs that ever came to our town. It was a proud moment when I first set up this tiny machine in front of our Sunday School and played "The Queen's Trumpeters." The horn was a tin megaphone suspended from my camera tripod.

School in those days left little to the imagination. The parrot style of learning was considered the thing. We did not have manual training. Somehow I got through school where drawing, geography and history were the only things I liked.

Then I went to Pratt Institute and spent four very profitable years studying drawing, painting, and in the latter part of my stay, interior decoration, architectural drafting and design.

The shops at Pratt attracted me very much and I spent considerable time in them, particularly the forge, foundry and machine shops, and I took short courses



Mr. Thatcher at the anvil in the forge end of his home workshop. He is a distinguished craftsman and specialist in decorative metal work, which he taught inspiringly for many years at Columbia University.

in some of these shops—my first real shop training.

When it became time for me to be graduated Professor Arthur Dow, who had frequently noticed my tendencies toward mechanics, advised that I take up wrought ironwork of the decorative sort, thus combining my liking for my hammer and my training as a designer. This appealed to me strongly, so, instead of taking a position in some interior decorator's shop I returned home, went to the junk yard and bought an old portable forge minus a lot of pieces for a dollar and a cracked anvil for another dollar.

THE forge had a good blower but a totally wrecked driving gear. I removed the crank hanger, sprockets and chain from an old bicycle and rigged them up to drive the blower. One pedal with the shoes removed served as a handle.

I bought a pair of tongs or two and some hammers, set my forge and anvil up in our cellar, and connected the hood of the forge to what I thought was a chimney flue. And I started work to become acquainted with the father of all the metal working arts.

As many tinkerers know, it is very hard work to drill a hole through iron with a brace and bit. I had no post drill, so I made one. A post was set up in the corner of my cellar shop and on this I rigged up the screw from an old vise so that it might be screwed down on the top of my brace. A stove lid on a bracket below served as a drill plate. Crude as

this arrangement was, it was a great improvement over the plain brace.

About this time my family noticed a rather smoky atmosphere in the dining room above the forge and that the lace curtains were considerably the worse. No wonder! The chimney hole to which I had connected the forge was no flue at all. This was a setback.

A friendly blacksmith, Albert Homer, gave me some tongs and hammers I sorely needed and, being a kindly sort of chap, as good blacksmiths usually are, he asked me what I was doing.

Now this blacksmith, who was the descendant of a long line of smiths in Sweden, was one of the best craftsmen I have ever been my pleasure to meet. He did not laugh or make fun of my crude efforts, but he said that I had better get some real training. He needed a helper. Why not come down to his shop and be one. Would I? Well, rather!

It made no difference to me that his shop was right on the "main street" of our town, in full view of all and sundry, or that I was supposed to be an artist and trained as such. Public opinion was very freely expressed, but much I cared!

For the best part of two years I swung the sledge over that good blacksmith's mighty anvil, about the healthiest and happiest two years that I remember. And I who had never been a rugged youngster found much health, happiness, and real knowledge at the forge of this friendly blond giant of a Swedish blacksmith. Many a horseshoe I helped him shape, and when we were not busy shoeing horses we took up my decorative work.

The very thorough training I received stood me in good stead. It was a solid foundation for the teaching of decorative metal work in all the years I taught this and other subjects at Columbia University. No small part of the work there was the teaching. (Continued on page 116)

Turn to page 74 for the continuation of the Home Workshop Department

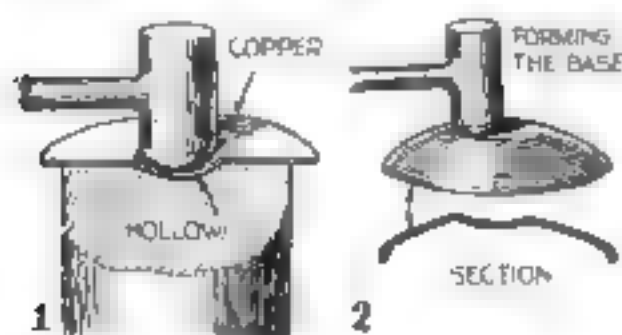


Fig. 1. The first step is denting a bowl on a block. Fig. 2. One method of forming the base.

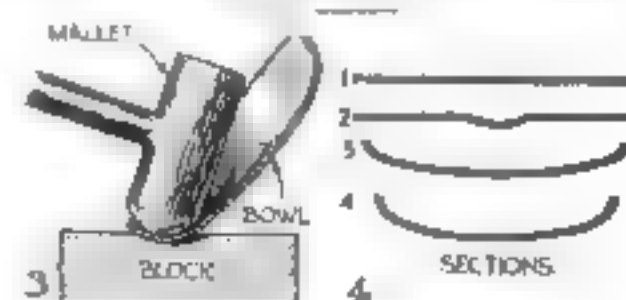
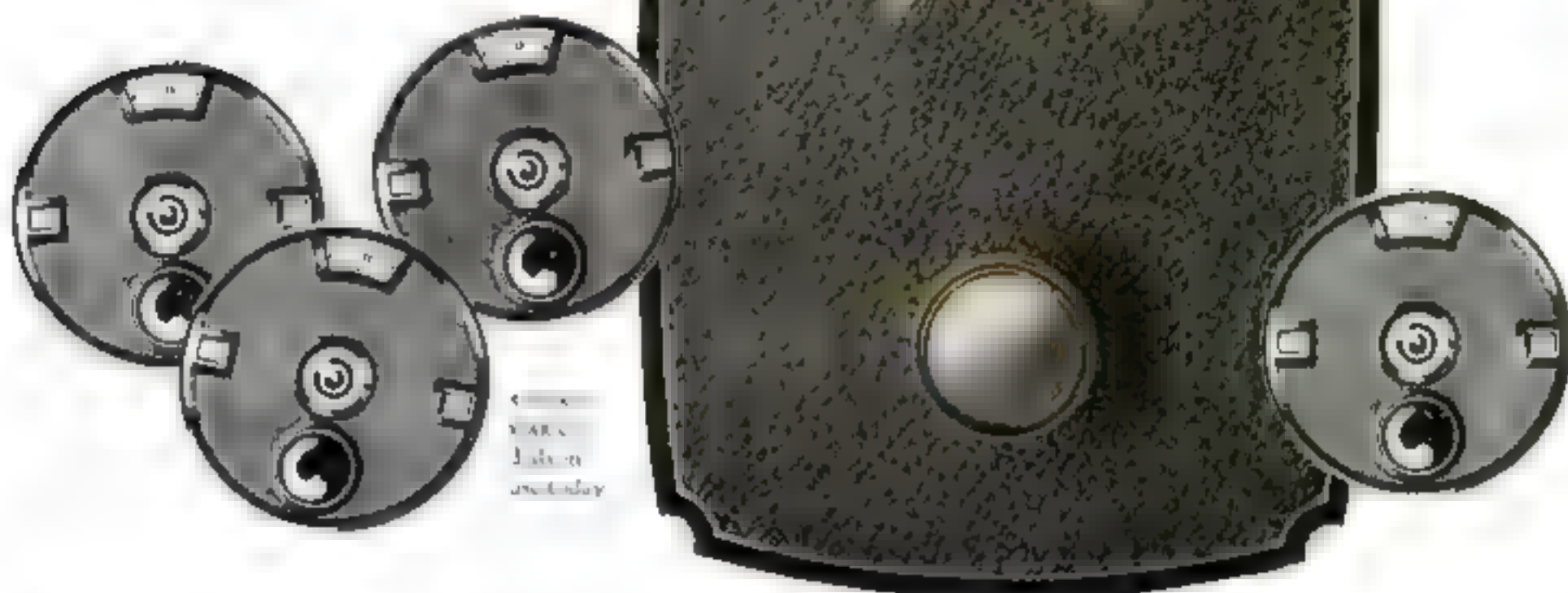


Fig. 3. Hammering the edge of the bowl. Fig. 4. Various stages of the forming process.

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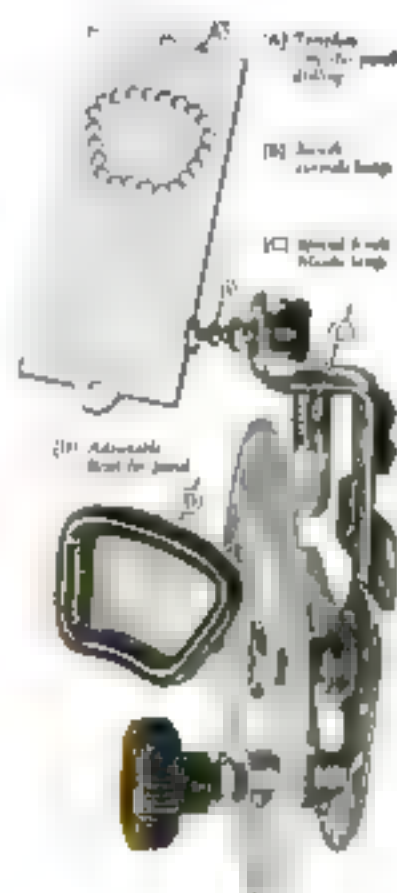


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MARCO Illuminated CONTROLS

The 5-tube receiver illustrated at the left shows the striking effect of MARCO illuminated controls.

Better Shop Methods

How Expert Mechanics Save Time and Labor



The Secret of Making Glue Stick

Old Bill Tells How to Be Sure of Strong Joints in Building Up Patterns and Doing Other Woodwork—Hints on Polishing Wheels

By H. L. WHEELER
Machine Shop Foreman

A CRACKING and thumping noise in a corner of Old Bill's pattern shop told in sharp, sudden terms that there had been an accident.

The big pattern Parsons had been turning left the lathe with a third. A glued joint had loosened and the tool had dug in with sufficient force to rip away a part of the pattern. Parsons stopped the lathe and surveyed the damage.

Old Bill, not far away, had heard the noise. He was soon at the scene of the trouble. Parsons ventured an explanation of what had happened.

"This glued joint loosened up," said he, pointing to the place where his chisel had gouged in, "and before I could do anything the job was on the floor. That joint ought to have been firm enough to hold, as it had set overnight with clamps on, and I can't account for its going to pieces in this way."

Old Bill made a quick but critical examination of the job.

"In the first place, Parsons," he said, "this joint looks as if it might have been glued better. There is an impression among many mechanics and especially among men who spend most of their time in the machine shop, as you do, that gluing up a joint is one of the easiest and simplest jobs in the world. As a matter of fact it calls for care and knowledge. Let's go over to the glue bench and I'll give you a few tips on how to make good joints."

At the glue bench Old Bill found things in a mess. Brushes were not cared for properly, and the pots needed cleaning.

"I HAVE depended upon you," he said, "to watch the little things at this end of the shop, but it looks as if these gluepots hadn't been cleaned in a month. The brushes are hard, dirty and, of course, full of bacteria. It's little wonder to me that your glued joint gave way."

"Maybe it's the fault of the glue," faltered Parsons.

"That's where you're wrong," said Old Bill. "The best hide glue won't hold if you don't have it fresh and everything you use thoroughly clean. The glue must be properly mixed and heated to the correct temperature, which should not exceed one hundred and forty degrees. This gives a margin of about five degrees

for cooling when taken out on the bench.

Glue is strongest at a temperature of one hundred and thirty-five degrees, and it is spoiled by overheating. It should be mixed only in small batches, about what you think will be needed for one job. Any old glue that has stood in the pot should be removed, or it will ruin the new batch. How did you melt the glue you used on your job?"



"To use glue properly," Old Bill told Parsons, "call for care and knowledge. Let's go over to the bench and I'll give you a few tips."

"There was a little glue in the bottom of the pot," said Parsons, "and I just warmed it and added more. It was very hot when I put it on, but probably it was too hot. I realize, after what you have said, that there is a lot to be learned about glue."

"A little of the old glue melted over might work well enough on some jobs," said Old Bill, "but when you have an important job it's best to be sure everything is right. In this case it is probably a good thing that the joint broke, rather than to have had it fail later on, as the job is for one of our best customers."

"But I don't get the idea of making fresh glue for each job," objected Parsons. "I took the pot with the least in, and there was very little. All the other pots contain glue, as you see, but I don't know how long it has stood. Why waste all

that glue? I can't see that it looks any different from new glue."

"That's just the trouble," said Old Bill. "You mix too much glue at one time and waste a lot more than is necessary. Old glue that has stood for some time loses its value in this way. It decomposes so rapidly that every precaution must be taken. What is left in the pot, even if overnight, loses a great deal of its strength, sometimes as much as fifty per cent. And when mixed with new glue the bacteria makes the whole batch nearly as weak as stale glue. In the case of this job, I think that is part of the trouble. But the other things I have mentioned, such as cleanliness and proper handling, also are essential."

Another thing to remember about glue is that it has a peculiar tendency to dry out as soon as it is removed from the pot. For this reason the work should be done as near to the gluepot as possible.

Drafts from open windows or other sources should be guarded against for glue will dry almost instantly if a draft strikes it. If the wood is cold from having stood in a cold place, it should be warmed before applying the glue. Don't forget, though, that when glue cools very rapidly it does not set to its full strength within forty-eight hours, often big jobs require a longer time."

LATER on two or three shopmates gathered around Parsons, while he was eating his lunch to hear news of the accident.

"The boss was a bit peeved about it," admitted Parsons, "but he gave me some good dope on glue and how to handle it, so I don't think anything like that will ever happen to me again. It was my fault for being careless when I glued the joint. Old Bill claims that improper handling will ruin any glue and I am convinced that he is right."

"I remember a job in a shop I worked in some years ago," Peters, one of the machinists, said, "that gave a great deal of trouble because the men didn't know anything about glue. A lot of expensive polishing wheels were being used and these had to be kept in condition all the time. They had

(Continued on page 124)

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 124 to 134.

CHERRY
INTERNATIONAL
NEWSPAPER



Off to a good start

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Trunks	Cabinets	Flower Pots	Refrigerators	Office Furniture	Washing Machines	Washing Machines	Washing Machines	Washing Machines
Pipes	Big Buildings	Bed Cases	Lawns	Clothes Hangers	Golf Clubs, etc.	Golf Clubs, etc.	Golf Clubs, etc.	Golf Clubs, etc.
Fences	Finishing	Sea Boats	Book Cases	Picture Frames	Fishing Rods	Fishing Rods	Fishing Rods	Fishing Rods

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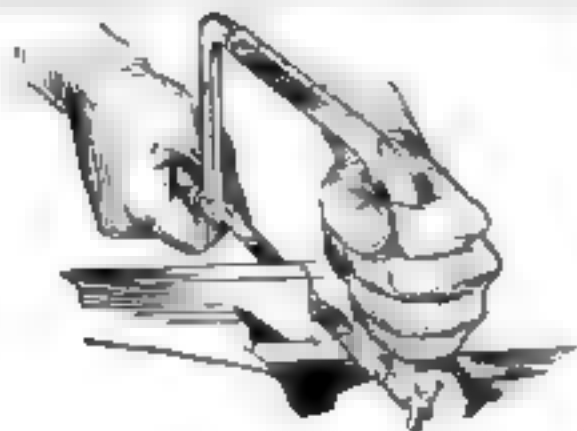
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STAR HACK SAWS



At Last—a Place for Rubbers

Special Compartment for Them Is Built into Umbrella Stand of Neat and Simple Design

By WILLIAM W. KLENKE

Instructor in Woodworking, Central Manual Training High School, Newark, N. J.

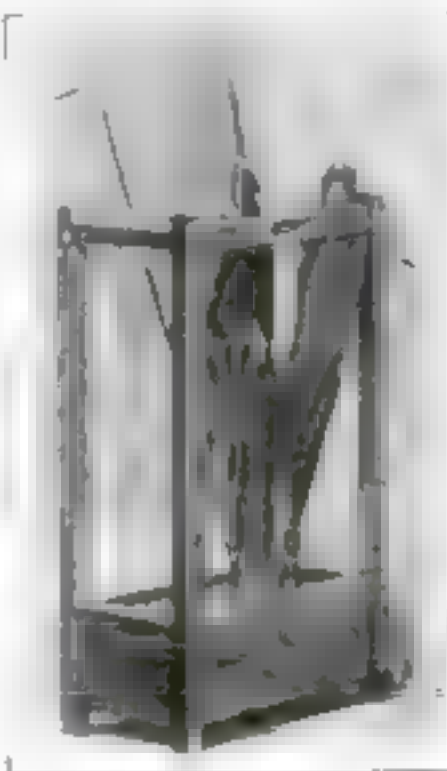
FRANK, one of the boys who worked in the shops at Central High School and was especially interested in woodwork, came to visit me at my home one Saturday during a light summer shower. I suggested that he put his rubbers and umbrella in the stand I had made for that purpose.

"Well," said Frank, "that's something new to me—a combination umbrella and rubbers stand. Mother has always wanted a place to put our rubbers as well as umbrellas. I guess I'll try to make one for her birthday. Will you show me how to go about it, Mr. Klenke?"

"Certainly, Frank. I have a blueprint in my desk with the list of materials and all necessary details. Here it is. Of course in getting out your rough stock, you must allow for dressing up the pieces to the exact size. Plane all the pieces true, with good, square ends on the rails for the dowel joints.

"I suppose I should mark on the various pieces, right front, left side, and so on," said Frank.

"That's right. Then to lay out joints, place each leg and rail that are to be jointed together in turn in the vise with



Neat and simple umbrella stand in mahogany, made by Mr. Klenke

the working faces out. Using a marking gage, make the center line. With a knife and try square, cross this line in two places, locating the centers for two dowels. By this method you are sure to get the points on both pieces alike. Now, using a number six auger bit—

"That means a three-eighths-inch bit, doesn't it?" asked Frank, eagerly.

"Yes, auger bit numbers increase by sixteenths of an inch," I answered. "With this bit bore holes three-quarters of an inch deep at each intersection."

"Shall I use a bit gage for depth?" questioned Frank.

"If you care to use one, but you must be careful not to mar your joint as it turns. I prefer to count my cutting turns. For every full cutting turn in the average wood, I figure the bit will enter one-sixteenth inch."

In other words," said Frank, "twelve cutting turns."

"That's correct. Bore the holes in all pieces, then cut the dowels to length. I either countersink the holes or chamfer the top of the dowel to make it easier to put the joints together. You remember

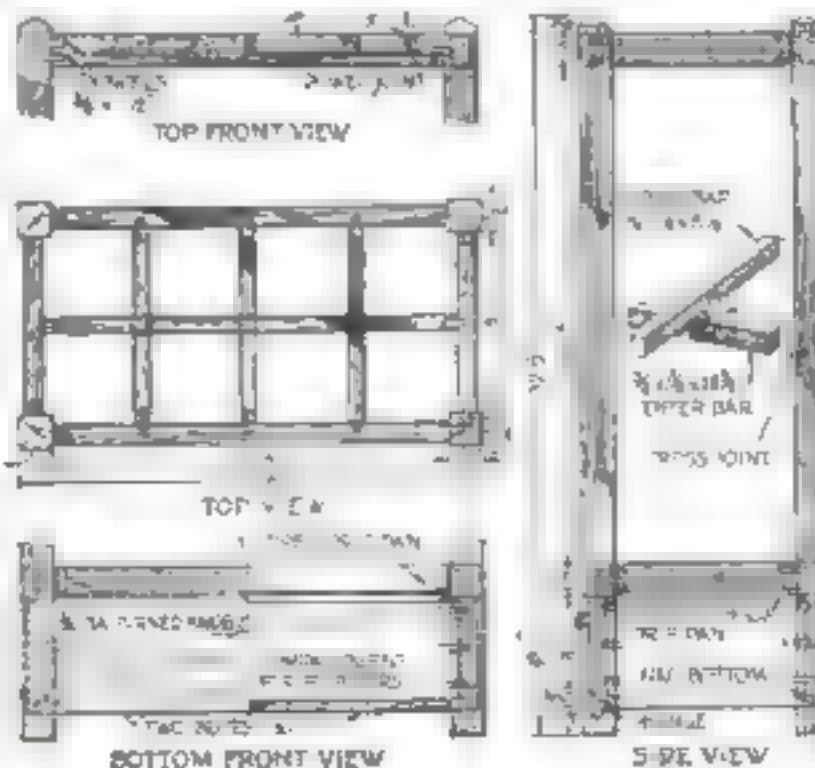
from making tables that you do the gluing at two different times. I should glue up the two short ends first with good hot glue or the best grade of liquid glue—not too thick—then the next day glue up the entire job."

"Do I have to glue up the framework at the top separately?" Frank asked.

"You may if you wish to, but I prefer to do it all at the last gluing, it is easier to get the entire piece square while the top is not rigid. Either way, however, will work out satisfactorily. When set, clean off all the glue and sandpaper thoroughly."

"Shall I use our regular bichromate of potash solution for staining?"

"Yes, Frank. If you want a brown tone on the mahogany," (Continued on page 113)



The working drawings Frank had to follow. The construction is a trifle simpler than that shown in photographic illustration



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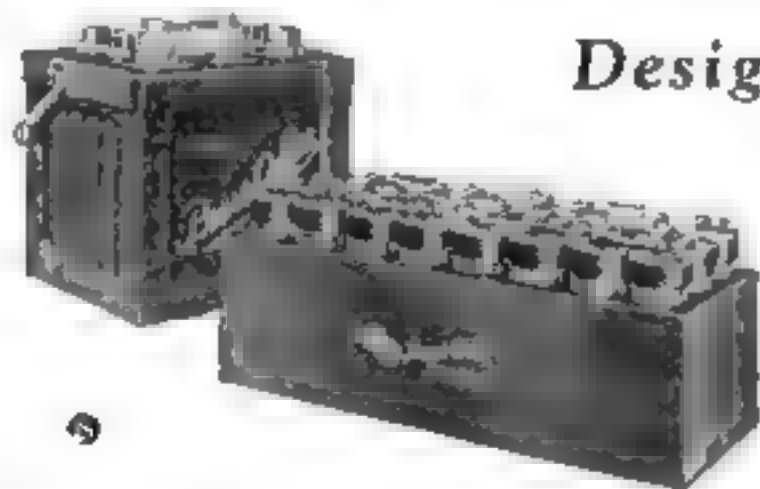
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The Home Workshop

DOVETAILES The Wonder Joints of Woodworking

By E. MANUEL F. FRICSON, Voted Master Tooling Authority



1. The first step in making a dovetail joint is to cut the waste out of the tail piece.

Any one who has ever seen a dovetail joint knows that it is one of the strongest and neatest of all the joints used in woodworking. It is a joint that is so simple in design that it can be made by anyone who has a little knowledge of the use of a hand saw and a chisel.



2. The next step is to cut the waste out of the pin piece.

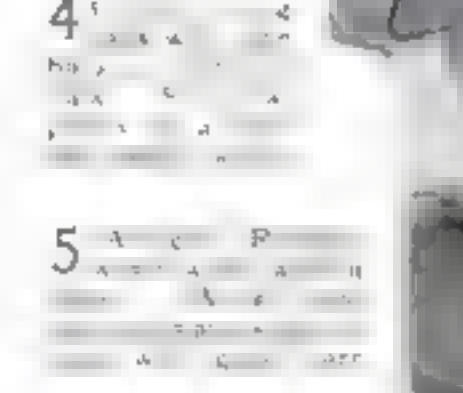


3. The third step is to cut the waste out of the tail piece.

There are many ways of making dovetail joints. The most common is the half-blind, lapped or stopped dovetail. This is the joint that is used in the front corners of a drawer. The through dovetail is used in the back corners of drawers and in the corners of chests and cases. The mitered dovetail is used in the corners of picture frames and in the corners of some types of cabinets.



4. The fourth step is to cut the waste out of the pin piece.



5. The fifth step is to cut the waste out of the tail piece.



6. The sixth step is to cut the waste out of the pin piece.

IF YOU will pull out one of the drawers of almost any well-built piece of furniture, you will find the front and sides are fastened together with a multiple dovetail joint—the aristocrat of wood joints. This is at once one of the strongest and neatest of fastenings at the command of a cabinetmaker.

It can be made in three principal forms

the half-blind, lapped or stopped dovetail, as at the front corners of a drawer; the through dovetail, as in high class boxes, chests and cases and sometimes at the back corners of drawers; and the mitered or secret dovetail, which outwardly looks the same as a mitered joint.

There are many ways of making dovetail joints. The ex- (Continued on page 108)

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NO matter what metal you cut—it will pass

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Considering the recent discussions pro and con on the value of college education, it is interesting to hear from an old graduate who found at least one subject useful in later life. That was pipe-smoking.

Read his letter

Larus & Brother
Richmond, Va.

It was at college that I learned to smoke. I grew to like it and I have since then done other things at college. I was a very busy fellow. Another was to learn the dead languages. Now fifteen years later I have given up playing football and studying dead languages, but have not yet given up smoking Edgeworth tobacco.

It was a sort of tradition for each fellow to throw off the top of a cigar and put on the "hook" of a pipe to adapt the smoking of Edgeworth as a habit out of his entrance into man's estate.

Being fortunate enough to enjoy the surprising mildness and sweetness of Edgeworth, I put the thought of his smoking pipe in my mind. I was a very busy fellow at college. I had many other things to do. I had to study hard. I had to work hard. I had to play hard. I had to smoke hard. I had to smoke Edgeworth.

Still smoking Edgeworth
A new, internally the answer has been Yes. I still like it better than any other. It is a very pleasant flavor. And it is mild. It never burns the tongue.

Signed) FRANK H. WILSON.



Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Company, 10-V S. 21st Street, Richmond, Va.

We'll be grateful for the name

and address of your tobacco dealer, too, if you care to add them

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed to small, pocket-size packages, in handsome humidor holding a pound, and also in several handy in-between sizes.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber

On your radio—tune in on WFLA, Richmond, Va. —the Edgeworth station. Wave length 256 meters.

Amazing Puzzles Formed from Easily Whittled Blocks

By ARTHUR L. SMITH

BLOCK puzzles may be made of combinations of the six-block puzzle described in the March, 1926, issue of POPULAR SCIENCE MONTHLY. They may be of more or less intricate character according to the solutions there offered.

As such a puzzle is apt to be quite intricate enough for the average person, no matter how simply constructed, we shall choose one of the easiest of the solutions (corresponding to No. VI in the first article). If extreme intricacy is desired, several of these solutions can be embodied in one puzzle, but such puzzles often lose their entertaining character more even the constructor may forget how to put them together.

The blocks used are $\frac{1}{2}$ in. square and 4 in. long. The cuts are $\frac{1}{4}$ in. deep and $\frac{1}{4}$ in. or 1 in. long.

For a six-block puzzle (Fig. 1) to be included in one of twenty-four blocks (Fig. 3), making one of thirty blocks altogether, (Fig. 5), the cuts are central as shown in B, C, D. For the twenty-four block puzzle the cuts are equidistant from the ends as in E, F, G. The illustration makes the character of the cuts and their positions sufficiently clear.

By making the six-block puzzle (Fig. 1) first and putting it together, the solution of the twenty-four block puzzle is practically mastered, for the assembling is the same in each case. It will require blocks put together in the order named: C, B, D, D, D, A. Fig. 2 shows the puzzle partly assembled.

Four A's, four E's, four F's and twelve

Not Hard to Make

IF YOU like to solve really ingenious puzzles—and who does not?—you will find the problems outlined by Mr. Smith in this article among the most fascinating of their kind.

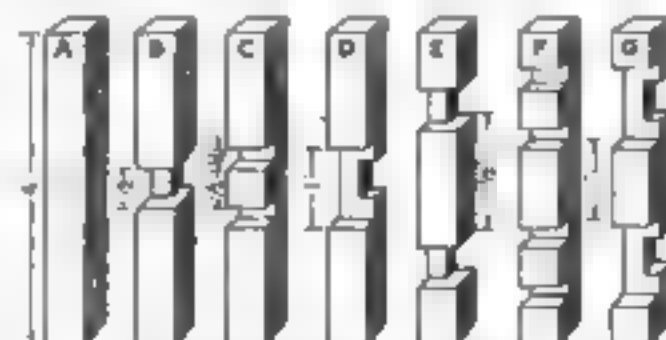
While Mr. Smith was led to write this article because of inquiries from readers who wished to put together twenty-four block combinations, it is not necessary to have read his preceding articles to understand the procedure in making and solving these puzzles. To whittle the blocks requires only a sharp pocketknife, a strip of $\frac{1}{2}$ in. thick pine, mahogany or other straight grained wood, and a little care and patience. And once made, the blocks will prove a source of never ending amusement and astonishment to your friends.

G's will be required for the twenty-four block assembly shown in Fig. 3.

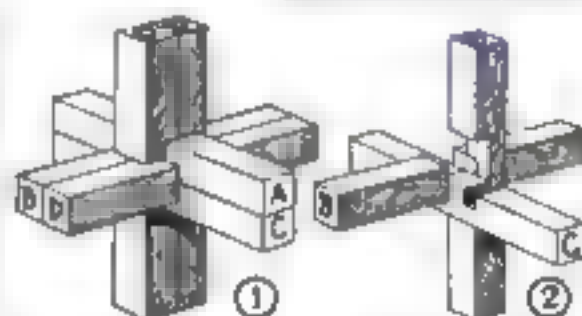
To put it together we first take F, F with E fitted in the cuts at the farther end. Then G, G and G, G are fitted in pairs on the E and F's. Another G is placed opposite E, binding the two G pairs. Fig. 4 shows these G pairs with E, G binding them at the bottom.

Unless the assembling is done in this way, one may find that more than two

(Continued on page 107)

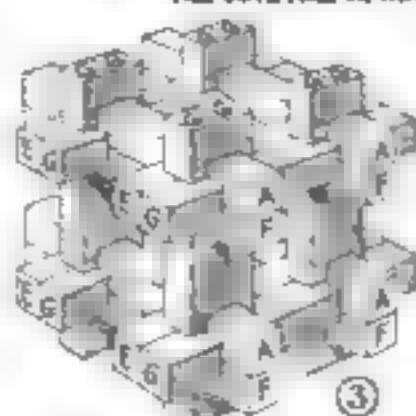


BLOCKS REQUIRED FOR THE 24 AND 30-BLOCK PUZZLE
ALL CUTS ARE $\frac{1}{4}$ IN. DEEP

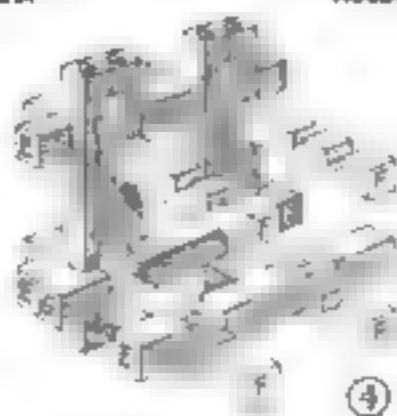


THE 6-BLOCK PUZZLE
ASSEMBLED

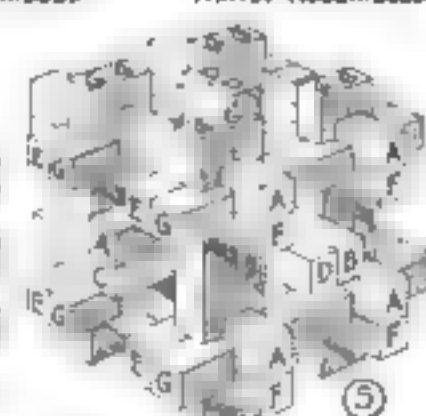
6-BLOCK PUZZLE
PARTLY ASSEMBLED



THE 24-BLOCK PUZZLE
ASSEMBLED



THE 24-BLOCK PUZZLE
PARTLY ASSEMBLED



30-BLOCK PUZZLE
ASSEMBLED

Intricate as the puzzles in Figs. 1, 3 and 5 appear to be they are made by combining blocks $\frac{1}{2}$ in. square and 4 in. long, whittled to the shapes shown in the upper left-hand corner of illustration



Artistically, this new Amplion Cabinet Cone graces the most exquisitely appointed drawing room—acoustically, it sets a new standard in radio reception.

AC12 . . . \$30

HERALDING~ a New Radio Voice

When genius sings or speaks or plays—a breathless silence follows.

When the new Amplion Cone reproduces vocal or instrumental tones—an awed hush ensues.



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A new model of the air column type—as pleasing to the eye as to the musical ear. Non-directional general diffusion of sound, 48-inch air column in an 18"x12"x9" cabinet.

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With this seven-piece set you can carve ships, birds, and other things. The London Addis set of tools is the only set of tools that the beginner can afford to equip himself with a very fine set right at the start.

The complete set consists of a steel ship carving knife, a steel bird carving knife, a steel carving tool, a steel carving tool, a steel carving tool, a steel carving tool, and a steel carving tool. The complete set is priced at \$4.30.

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Enclosed is \$4.30 for which please send me by return mail your set of London Addis carving tools. It is understood that if I am not satisfied in every respect you will return my money.

Name _____
Street _____
City and State _____

The Home Workshop

A Beautiful Clipper Ship

(Continued from page 61)

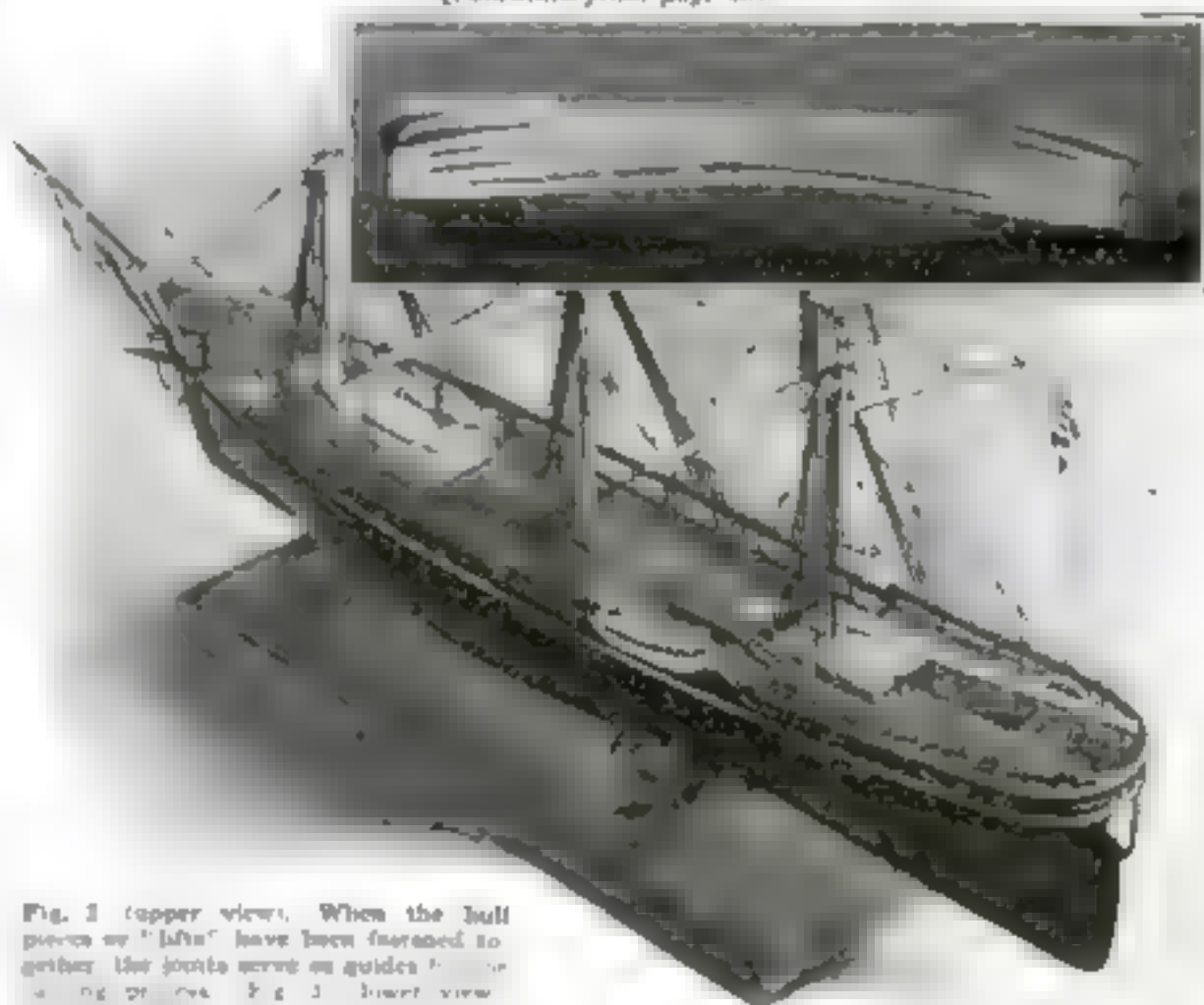


Fig. 3 (upper view). When the hull pieces or "lifts" have been fastened together, the joints serve as guides for the deck fittings. Fig. 3 (lower view) shows how the deck fittings should be placed.

a run between Honolulu and New York she made 411 miles in one day, 1478 in four days, and 3302 miles in 11 days, or an average, allowing for the difference in time, of 13 1/4 knots. On another run she sailed from New York to Liverpool in 13 days 23 hours, which has never been equaled in the month of June.

The *Sovereign of the Seas* was sold to a Hamburg firm and was wrecked on the Pyramid Shoal in the Straits of Malacca, August 6, 1859, becoming a total loss.

Her length at the load line was 231 ft., which, at the scale of 1, 1/8 in. to the foot, gives us a model 19 1/4 in. long at that line, or 20 in. long and 16 1/4 in. high over all. This is a comfortable size for the average room. To make it smaller is not advised, but it can be made larger by increasing all the measurements proportionately.

The first necessity is a full sized drawing of every part to be made. You can save yourself the formidable and time-consuming task of making these drawings by sending 75 cents to the Blueprint Service Department, POPULAR SCIENCE

MAGAZINE, 250 Fourth Avenue, New York, for Home Workshop Blueprints Nos. 51, 52 and 53 (see page 64). These contain the original drawings used in the construction of the model, which, with the exception of some smaller explanatory sketches, are all full size, including the rigging plan.

Too many models are ruined by trusting to the unaided eye, so measure each part carefully, and endeavor to keep down to the measurements.

It is well to make clear here that the writer does not claim that everything in the model is an exact replica. Authoritative plans and contemporary pictures have been used in the designing, but some fittings can only be given as probable and it is not always possible to adhere to exact scale. For example, the skysail yards should be 1/24 in. in diameter and the laces for those yards should be no thicker than the finest sewing silk, but it is advisable to make such parts slightly oversize. As another example, the deck plank markings should be thirty-six to the inch, which (Continued on page 88)



Fig. 4. Plan view of the deck showing the fittings. This plan is given full size on Blueprint No. 52. In addition, this blueprint has the complete details of the deck and cabin houses and various parts.



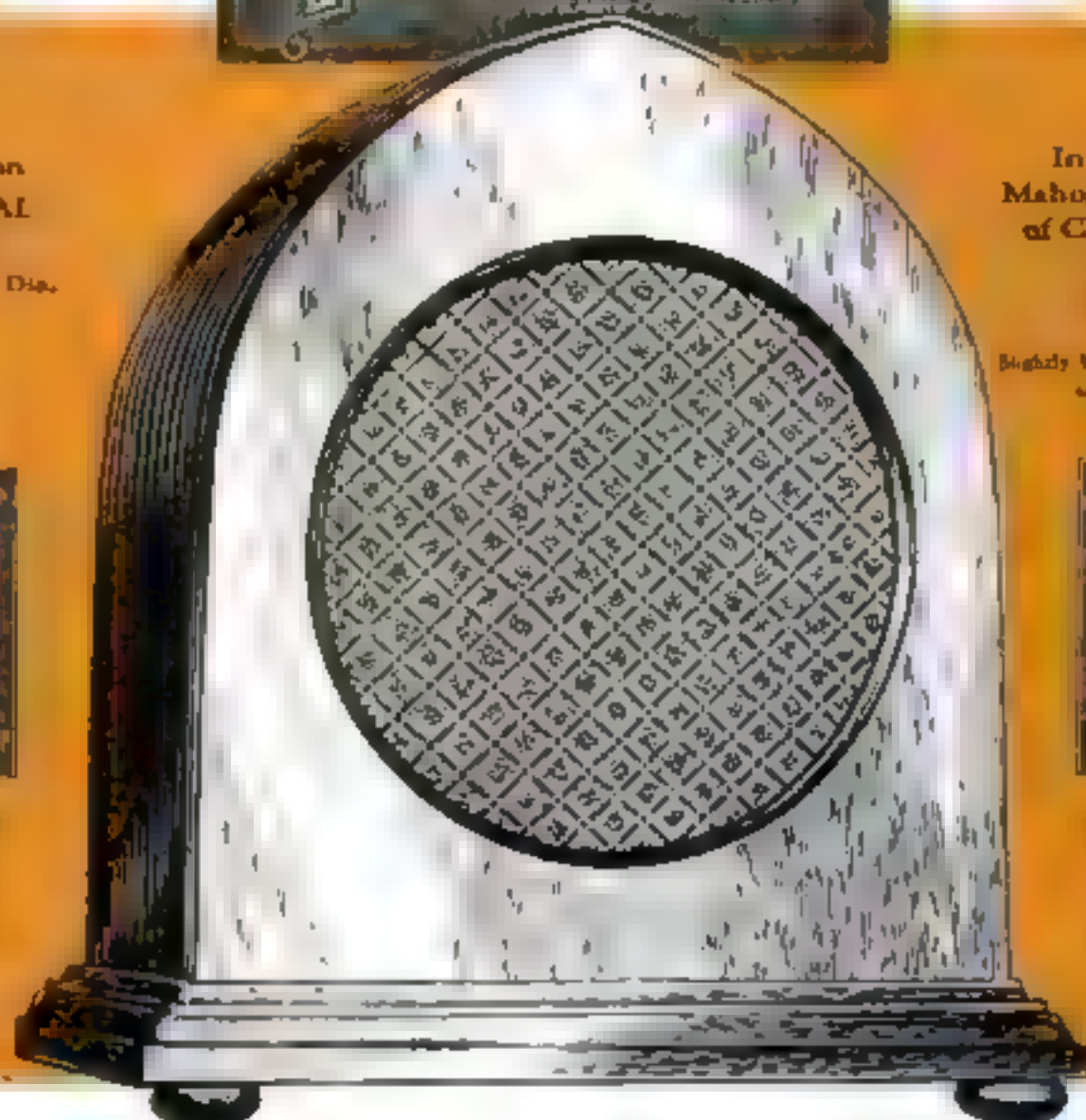
Illustration
1 ACTUAL
3 SIZE
Less Only 6" Dia.

In Beautiful
Mahogany Cabinet
of Classic Gothic
Design
\$35.00

Slightly higher cost of better
wood in Canada



The new Peerless
Reproducer is a
complete radio set
in one unit. It is
the only radio set
that can be used
as a table set or
as a floor set.

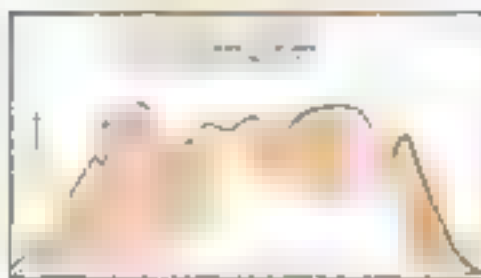


The new Peerless
Reproducer is a
complete radio set
in one unit. It is
the only radio set
that can be used
as a table set or
as a floor set.

A strange trick of the human ear may be robbing you of half your radio pleasure

FROM infancy, your ears have heard music direct from some original sound-source. Listening directly to an organ, a violin, a piano, or a band, your ear caught all the overtones and harmonics. Subconsciously you memorized the sounds with every fine harmonic shading.

Today, when you sit before your radio, if your loud speaker fails to reproduce the high harmonics or the low throbbing bass, your imagination supplies the missing frequencies! You think you are really hearing what actually you are only remembering! Without knowing it, you are straining to hear! "Listeners' Fatigue" results. You miss half the beauty of the original rendition trying to hear what your speaker will not reproduce.



A comparative frequency chart of two speakers in operation. One a typical horn type. The other, the Peerless Reproducer. The red-shaded areas show exactly what you miss with old-type speakers—and what you get with the Peerless Reproducer.

The new Peerless Reproducer gets these formerly "Lost Frequencies." How much more than the average, the chart shows. A new principle is responsible for this amazing result. The small diagrams above show its fundamental differences but only a Comparative Demonstration will prove these differences to your ear. This demonstration is free, but will be a revelation. It may be heard in the stores of two thousand Peerless dealers from coast to coast, and in Canada.

Meantime, send for a booklet of tell-tale loud speaker facts. Just ask for "Voices from the Air" on a post-card or in a letter. Or merely write your name on the margin of this page and mail it. The booklet is informative!

UNITED RADIO CORPORATION, ROCHESTER, NEW YORK



Motorize your Workshop with an Electric Drill

A GOODELL-PRATT Electric Drill will double the joys of your workshop.

Besides being efficient, powerful machines for fast drilling in wood or metal, they are in reality portable power plants that any ingenious craftsman can adapt to drive light lathes, bench saws, polishing and grinding heads, jig saws, bench planers, etc.

Just think of the innumerable

possibilities such a shop offers. How much more fun you can get out of it with power-driven equipment to do the roughing out and uninteresting parts of your work.

Goodell Pratt Electric Drills are made in six sizes with Universal Motors for either Alternating Current or Direct Current at 110 or 220 Volts.

Write for descriptive folder and prices.

The Goodell-Pratt Electric Drill is made in

$\frac{1}{8}$ Inch Heavy Duty
 $\frac{1}{4}$ Inch Heavy Duty
 $\frac{3}{8}$ Inch Light Duty

$\frac{1}{2}$ Inch Standard
 $\frac{3}{4}$ Inch Heavy Duty
 $1\frac{1}{2}$ Inch Heavy Duty

Powerful motor; long, patented, high-speed, self-oiling armature bearings; wide-faced, specially heat treated gears that run in bronze bearings; new self-tightening chuck; ample ventilating system; quick accessibility of all parts; handy switch control and absolute cleanliness—these are some of the improvements that make the Goodell-Pratt Electric Drills truly remarkable in performance and wonderfully free from trouble.

GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

MAKERS OF *TooltSmiths* MR PUNCH

GOODELL-PRATT

1500 GOOD TOOLS

The Home Workshop

A Beautiful Clipper Ship

(Continued from page 81)

would only result in a mess of lines.

The body of the hull (Fig. 1) is constructed of six lifts or layers, each $\frac{5}{16}$ in. thick (that being the usual thickness of planed $\frac{3}{4}$ -in. white pine). To make them, take six pieces of such white pine, free from knots, not less than $3\frac{1}{4}$ by 20 in., and scribe a midship line right around the center of each. Mark one of the outlines A, B, C, D, E, and F on each.

The best way to do this is to transfer the lines directly from Blueprint No. 51 to the wood by means of typewriting carbon paper. Mark at least three of the construction lines on the under side of each lift, say Nos. II, IX, and XI. Another way is to make a tracing for each lift and paste it temporarily on the wood to be sawed out.

Cut these pieces to shape with the fret saw, being very careful never to come inside the lines, it is better to leave about $1/32$ in. of wood outside them. Sandpaper off all inequalities. The bottom lift

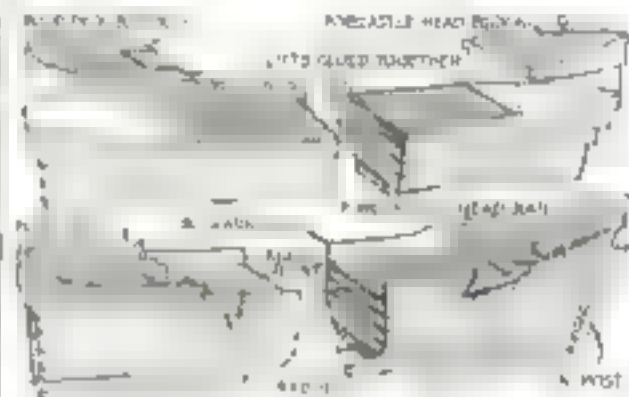


Fig. 3. How the "lifts" are assembled; the bulwarks, rails, stem, sternpost, and keel.

(A) is only $4/16$ in. thick; the extra should be planed off before cutting.

The $1\frac{1}{2}$ in. is the old-fashioned "line" measurement, which will be found on some rules. The scale with twelve divisions to the inch has been drawn on Blueprint No. 51 and can be cut out and pasted on a rule or strip of cardboard.

To make the model hollow, lifts B, C, D and E may have their centers cut out. To do this mark the top of the piece underneath on the bottom of each and with that side up, saw to keep at least $3/8$ in. within the line.

The pieces project at the ends to form the stem and sternpost; these may be cut off and vertical pieces fitted after the hull is shaped. The keel comes later.

Glue the lifts together most carefully (Figs. 2 and 3), so that the midship lines make one straight vertical line, and so that the construction lines coincide exactly. To do this in one operation, I found it easiest to start at the bottom, lightly nailing each piece to the next, on the inside, as it was placed, and making sure that no nail heads projected.

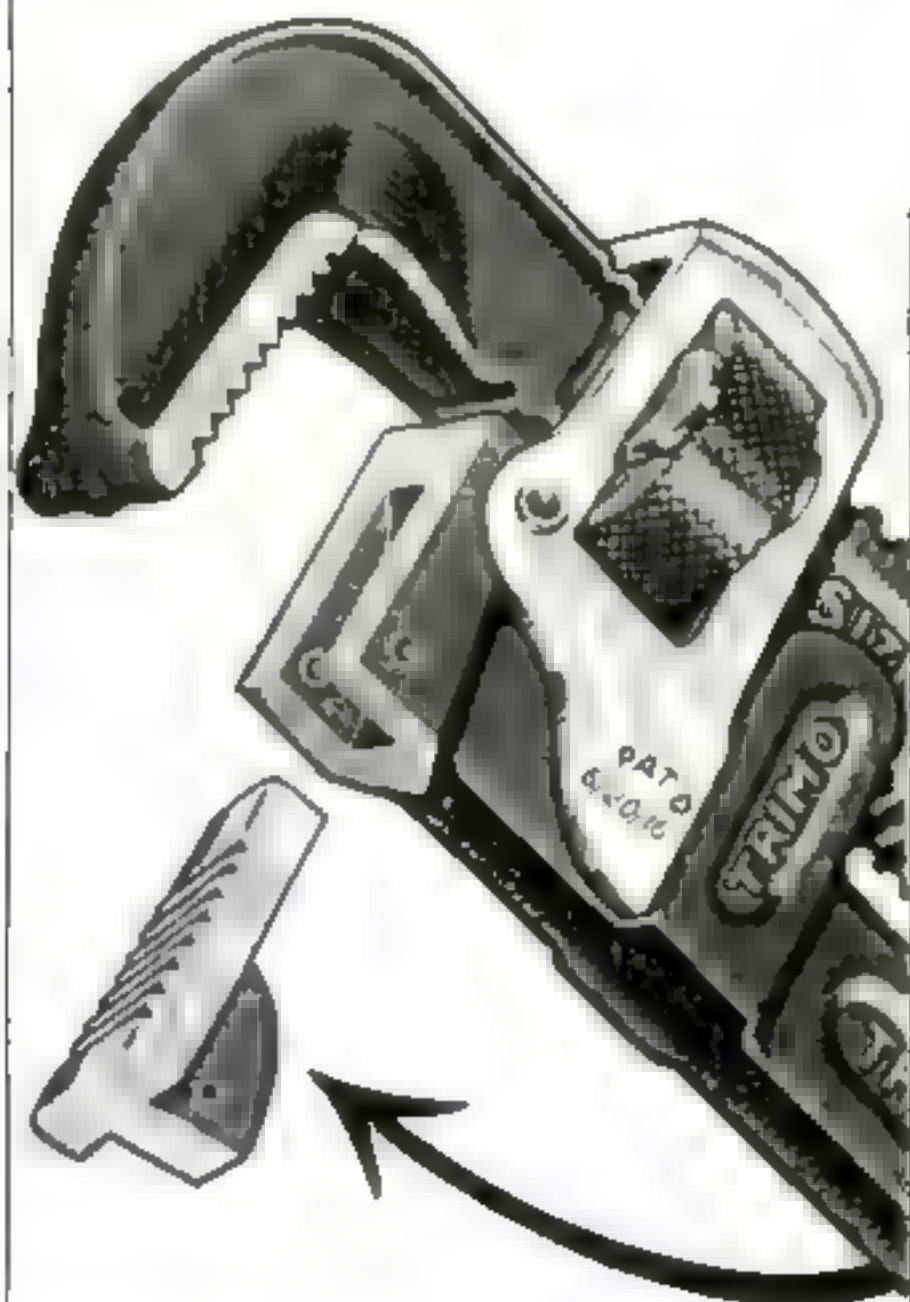
When this is done, put the whole in clamps or under weights and set aside to dry for at least 12 hours.

Next cut the sheer or curve of the deck line. This starts forward between III and IV (Fig. 1) and continues to the stern. The deck should have a slight camber or downward

(Continued on page 84)

TRIMO

The Pipe Wrench with the Replaceable Insert Jaw and Nut Guards



TRIMO PIPE VISE

A HANDY, rugged tool for home, shop, or farm. Has tempered, tool-steel jaws with fine-milled teeth which grip firmly. Yoke, frame, and base are of guaranteed malleable iron. Screw head, and handle are of selected steel. Patented device insures smooth hand grip. Made in seven standard sizes. Absolutely guaranteed.



WHEN large American tool buyers (railroads, oil companies, power plants, plumbers, etc.) have to settle the question of wrench economy, TRIMO almost invariably gets the verdict, even though the first cost of this rugged Pipe Wrench is a few cents more than others. Why is this?

Just consider one point alone—the INSERT JAW in the handle, an exclusive TRIMO feature. After the TRIMO has rendered long and hard service, this jaw can be quickly replaced at small cost. With other makes an entirely new wrench would have to be bought. NUT GUARDS which keep the TRIMO adjusted constitute another economic (time and labor saving) feature. Pressed steel frame is practically unbreakable.

Replaceable parts, maximum strength, masterly design, and many other exclusive points have made TRIMO the preferred Pipe Wrench among large and small users for nearly 40 years. Made in eight steel-handle sizes from 6 to 48 inches; four wood-handle sizes, 6, 8, 10, and 14 inches.

At all hardware, mill, plumbing, and oil-well supply stores. Insist on TRIMO—accept no other.

TRIMONT MFG. CO.
ROXBURY - MASS.

What about this Silent NOKOL automatic OIL HEAT?

It is a sensational new
discovery in home-
heating comfort

FREE:
Coupon below brings
valuable new book

HERE are some facts about the
most modern oil heat for any
home:

Noise has now been cut to the
vanishing point.

High efficiency, which for nine years
past has established records for lowest-
cost, fully automatic oil heat—is now
actually increased.

More comfort than ever before is
delivered at the same low cost.

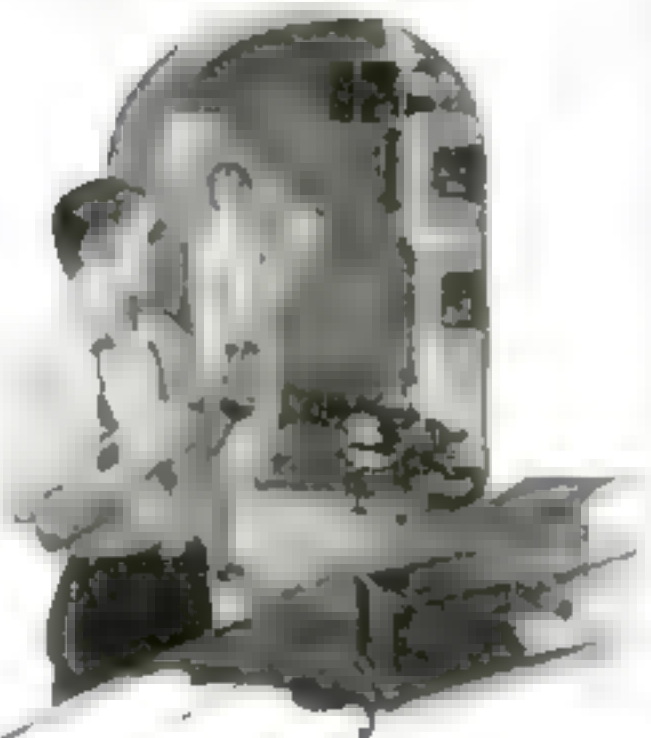
Right now, as a result, shrewd Ameri-
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and-a-half million dollars—monthly—in
Silent NOKOL installations.

More than 35,000 homes have had
NOKOL comfort for periods up to nine
years!

What it offers:

NOKOL-owners usually pay less for
their heat than hard-coal would cost;
never more.

There is not, never has been, "oil-burn-
ing" odor in or about any NOKOL-heated
home. Because NOKOL does not have to
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He can hear the clock—but cannot hear his new Silent NOKOL.

This comfort is for small homes, or
large. NOKOL is one of the few auto-
matic oil burners made in sizes to suit
any home.

New Book—FREE

Send coupon below and learn where,
in your own vicinity, the new Silent
NOKOL may be seen. You will also re-
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Dept. 17—215 N. Michigan Ave., Chicago
Gentlemen: Please tell me where to see the new
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NOKOL
AUTOMATIC OIL HEATING FOR HOMES

First domestic oil burner listed by Underwriters' Laboratories—approved by all leading
insurance companies. Manufactured and guaranteed by AMERICAN NOKOL COMPANY, Chicago

The Home Workshop

A Beautiful Clipper Ship

(Continued from page 83)

curve from the center line toward the
sides.

This is a convenient time to pencil the
lines to represent the edges of the deck
planks. They are marked about 1 1/2
in. apart with a very hard, sharp pencil
and should run truly fore and aft.

Make the pieces G and H (Figs. 1 and
5) for the fore-castle and poop. G is 3/4
in. thick at the bow and 1/4 in. at its after
end. The top is considerably wider than
F to allow for the flare at the bow. Piece
H has a square cut out of it to take the
cabin house; it flares out at the stern.
Glue these in place.

FROM thin cardboard cut 13 templates
from the vertical profile body plan
(Fig. 1). Fix the hull on its side in the
vise, being careful not to bruise it with
the jaws. Saw away the lower corners
of the lifts until you are down to the up-
per joints of each. While doing this keep
try ing on the templates, noting especially
that the curves in some places, as at the
lower part amidships and upper part aft,
are convex and at the ends concave
(hollow).

A chisel, flat gouge, plane, spokeshave,
and half-round cabinet rasp are all useful
in this work, especially the latter, but
not all are necessary. Be very careful
with the hollow under the stern and the
flare at the bow. You will find a very
beautiful and absolutely correct hull will
emerge.

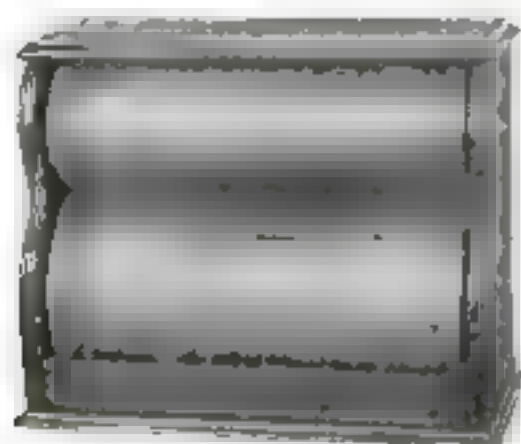
If the ends have been left on the pieces,
be careful with them and have a distinct
angle between the end posts and what is
supposed to be planking. If you have cut
them off, leave the ends flat enough to take
the posts—a full 1/4 in.

The bulwarks (L, Figs. 1 and 5) come
next. Cut rabbets 3/8 in. into the sides
of the hull and extending 3/8 in. down
from the deck line, as shown in Fig. 5.
Into these fit pieces of white pine 3/8
in. thick and 3/4 in. wide. Glue and
lightly nail them to fore-castle, poop and
hull sides. The forward end may need
steaming to twist it; have them a shade
thick and when in position sandpaper to
meet the rest of the hull.

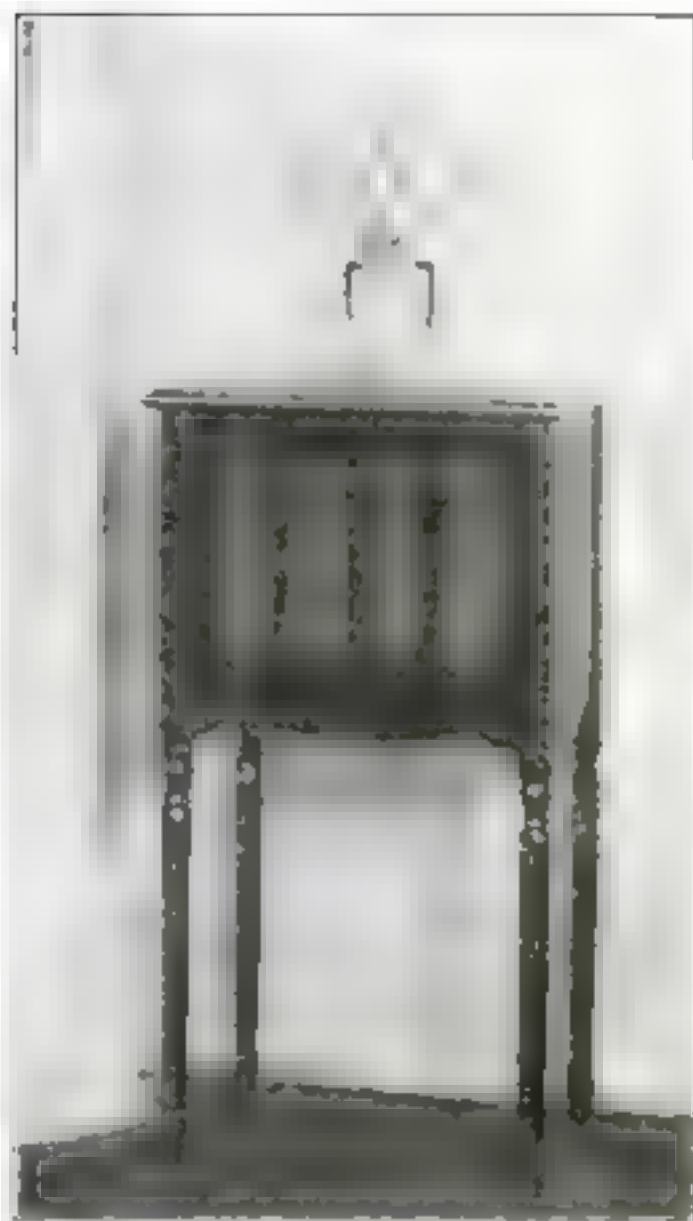
FROM a piece of pine 1/4 in. thick cut
a horseshoe-shaped piece (I) to lie on
the poop, which will continue the inside
line of the bulwark. It had better project
considerably on the outside and be shaved
down to the hull lines after being glued.
Make a similar piece (J) for the fore-
castle, which, inside and out, will have to
continue the flare at the bow. These
must be neatly joined to the bulwark
pieces where they meet.

For the keel (K) cut a groove along the
bottom of the hull 3/8 in. wide by 1/8 in.
deep. Into this glue and nail a strip of
pine 3/8 in. deep by the same width. Have
it extend beyond the hull sufficiently to
come under the stern and sternpost. If
these are to be added, they come next, their
shape will be seen in the sheer plan (Fig. 1).

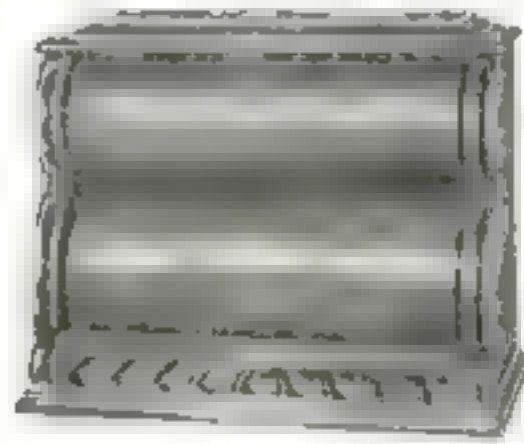
The two moldings (Fig. 3) come next.
They can be (Continued on page 85)



THE STANDARD MODEL
Two-tone mahogany,
hand-rubbed finish. \$16.50



THE TABOURET MODEL \$40.
Brown finish mahogany
All prices slightly higher on the Pacific Coast and in Canada



THE DE LUXE MODEL
Solid walnut, hand-
carved. \$25.

Found: Radio's Lost Chords

Here, indeed, is a new speaker—new in principle, new in performance, new in artistic charm.

It is a speaker that finds, and delivers, the "lost chords" of radio.

It brings to you every instrument in the philharmonic orchestra, every voice in the augmented chorus, with

every delicate shading of tone.

It was developed and perfected by acknowledged sound-scientists in the laboratories of Dictograph, famous in the realm of acoustics.

Of course, you may try it, with the compliments of your radio dealer.

The New DICTOGRAPH ROLL SPEAKER

Made by the
DICTOGRAPH PRODUCTS CORP.
New York City

The difference between Success and Failure



Very Often Success or Failure is determined by a minute adjustment — a smoothing of the surface for Better Contact and Fit

Machinists and home tool users appreciate the NICHOLSON File for this work, because they can depend on its uniformity—its sharp, biting teeth that resist wear caused by constant usage.

Your local hardware dealer is well stocked with a complete assortment of NICHOLSON Files, and will help you select the right files.

NICHOLSON
U.S.A.
(TRADE MARK)

NICHOLSON FILE CO.
Providence, R. I., U. S. A.

—A File for Every Purpose!

The Home Workshop

A Beautiful Clipper Ship

(Continued from page 84)

made from wood but hard cord, such as fishing line is easier to handle and just as good. The lower one should be about $\frac{1}{16}$ in. in diameter. Starting at the bow it follows the arc of the main deck. Stretch and glue it along, being careful to keep it in position with a few pin points. The top molding should be about half as thick and be level with the edge of the bulwarks.

For the hawse pipes bore a $\frac{1}{8}$ -in. diameter hole, $\frac{1}{8}$ in. deep in each bow, $\frac{1}{4}$ in. abaft the stem and $\frac{1}{4}$ in. below the lower molding. Point it toward the middle of the fore-castle head. It is a round hole, but the angle at which it is bored gives it an oval entrance. Paint it red inside. Carefully bore a $\frac{1}{4}$ -in. hole for the bowsprit and then make the figure-head. Stack two pins in the stem, one for the head, the other for the extended arm. On these build up the figure with green or thick paste of aquad glue and whiting with a little linseed oil and varnish to represent a queen with flowing robes, one arm extended forward and the other backward along the hull. This figure might be carved from wood. If you do not wish to attempt the figure, just put a wooden cord under the bowsprit, called a bidlehead.

The figure head should be white and gold and the scrollwork design should extend back to the hawse pipes.

A HANDRAIL (M, Fig. 4) will be wanted round the poop deck. This is most easily made from a piece of flat rattan cane, a scant $\frac{1}{8}$ by $\frac{1}{2}$ in. Measure off sufficient to go round, and at the middle and at $\frac{1}{4}$ in. intervals drive $\frac{1}{8}$ -in. long points from back pins through it. On these drop two or three beads, fastening them with a spot of glue, to make a rail only $\frac{1}{4}$ in. high. Invert this and drive the pin points into the edge of the bulwarks.

Make and fix the wooden catheads (N, Fig. 4), $\frac{1}{4}$ in. sq. and 1 in. long, and the bumpkins (O), which are $\frac{1}{4}$ in. long. They should project through the rails.

The rudder is a slip of wood, thinned down toward the stern edge. It projects a little into the hull and is fastened on with pins or nails pointed at both ends.

Now draw the plank lines on the pieces H and G, if it has not been done previously, and give the entire deck a coat of thin varnish.

Scratch the water line where shown in Fig. 1 and give the hull a priming coat of flat white paint. When this is dry, sandpaper down and fill in any inequalities with white lead, or thick paint.

Sandpaper again, then give the upper part a coat of black and the lower a coat of dark green or the color known as 'light red' if you prefer. Rub this down and apply another coat, finally rubbing down with pumice stone and water to take off the extreme shine.

The top edges of the bulwarks are black along the waist and white at the fore-castle and poop. The lower molding is white. The inside of the bulwarks is white, with

(Continued on page 89)



Constant Dependable B Power Direct from Your Light-Socket is Now a Reality in Majestic Units



Give that set of yours the power it needs—power for any variation in tone. Then you'll have a new appreciation of radio. You will have one delightful program after another—summer evenings—winter evenings—*All the Time!*

That's when your set is equipped with Majestic "B" Current Supply. Your set seems *Alive* with marvelous energy. You sense a new joy in radio.

Reliable, unvarying power at an average cost of about one-tenth cent an hour! Economical, powerful—Lasts as long as any Receiver. Fully guaranteed.

Majestic "B" Current Supply

delivers pure direct current—From your light socket

You at last forget its mechanics, for a simple switch releases all the power you need for any program. Power—*clean—constant—abundant!* Power that instantly responds to high soprano, and as easily brings you the full resonance of an orchestration!

Their low purchase cost and the savings they bring to you make them an investment that soon is repaid. Don't delay—see your dealer at once or write for free literature.

DEALERS: If you are not yet equipped to get your share of the Majestic business, see your jobber or write direct giving us his name.

New York Show—Booth No. 10—Section "B"
Chicago Show—Booth No. 6—Section "F"

No Filament to Burn Out

All the Majestic "B" Current Supply units are manufactured complete in our factory and are equipped with the famous Raytheon tube (endowed by our master radio engineers and editors) which is a non-filament tube with full wave rectification—no arcing or back surge. Tests of the Majestic "B" on the oscillograph demonstrate that all A-G hum is entirely eliminated.

Majestic Standard-B Current Supply

Especially adapted for sets having not more than seven 201 A tubes, or six 201 A plus one 133 150 volt power tube. Popularly priced for the average set—improves tone—better reception.

Price \$32.50
West of Rocky Mts. \$35.00

Majestic Super-B Current Supply

Capacity 2 to 12 tubes including the use of 133 150 volt power tubes. Complete with switch to control current from light socket.

Price \$35.00
West of Rocky Mts. \$37.50

Majestic Master-B Current Supply

Rating 60 ma. at 150 volts. Particularly adapted for Radiola 25, 28 and 30 and superheterodynes. Will operate all power tubes, also the new super power tube UV 171 (250 volts). Unequalled for sets having a very heavy current draw.

Price \$42.50
West of Rocky Mts. \$45.00

GRIGSBY-GRUNOW-HINDS CO.
4578 ARMITAGE AVENUE CHICAGO, ILL.



Put
Your Radio
in **STYLE**

61

The
NEW "*Aristocrat*"
Vernier Port Dial



free!

The International Union of
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 has decided to name the
 element with atomic number
 104 after the Soviet Union.
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 discovered in 1964, was
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THE KURZ-KASCH COMPANY DAYTON, OHIO

Moulders of Plastics

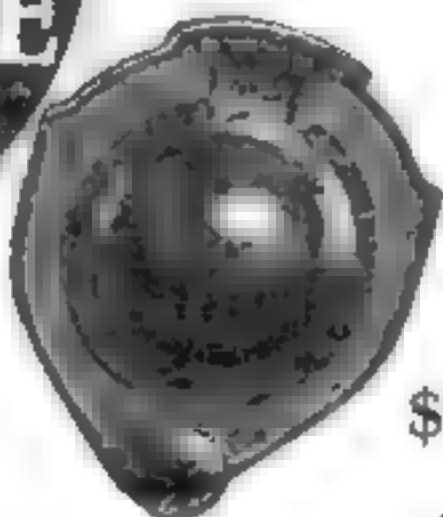
KURZ  **KASCH**
Aristocrat Dials and Knobs

\$1⁰⁰



Aristocrat E-Z TOON
Vernier Pointer

\$2⁰⁰



36 He me Wc-keheo

A Beautiful Clipper Ship

Continued from page 527

brown stripes to represent teakwood paneling.

While the paint is drying, one can be making the deck fittings (Fig. 3). The cabin house (F, Fig. 4) is a block of soft wood and sets into the poop deck. It projects $\frac{1}{2}$ in. It should have a molding round the top edge and be white, with doors and windows painted on. The forward deck house (G) is similar, only larger.

The hatches are blocks of wood, with a groove cut round them. The after one (R) has a slide opening under which is supposedly a ladder leading to the hold. The companionway (T) on the poop is very similar, but white with painted doors at the after end. The skylight (U) also is a block of wood, with barred windows, recessed and painted, round the sides.

The bunade (Y) is a similar block, paneled. These may have very thin cigar-box wood tops.

THE steering gear (W) is a block of wood set on pin-and-head legs, right over the rudder trunk. The wheel can be a gear from an old watch, with every other tooth filed away, or can be cut from a thin sheet of resinsoid or brass.

The bitts (X) are made from $\frac{1}{4}$ -in. sq. wood—two uprights set in the deck with a crossbar (holder, recessed into them and stained brown. The after bitts are set across the inner ends of the bumpkins. The ladders can be fashioned from $\frac{1}{4}$ by $\frac{1}{2}$ in. sugar-bark wood, or cut from cell-lulor. They lead, one on either side, from the main deck to the fore-castle head and poop deck. Two or three steps are enough.

The life rails (Z) around the masts are made from $\frac{1}{2}$ -in. uprights, with $\frac{1}{4}$ by $\frac{1}{8}$ in. horizontal pieces. The after ends of the one at the main are supported by pin-and-bowl posts, and have three cut-off pins through them on either side, to represent belaying pins. The after ends of the forward life rails are merely glued to the front of the deck house.

ON THE forecastle there will be a capstan (AA) fastened to the deck with a long pin. It may be painted green or black. There will be three posts for windlass bolts (FF), the larger and forward one $\frac{3}{4}$ in. high and the others $\frac{1}{2}$ in. high these extend from the windlass underneath. There can also be a bell (KK) at the front edge.

On the top of the deck house there will be two boats (CC) glued and lashed to skids (crossbars), and the guley funnel (MM), painted black.

Staples, made by bending over stout pins, will be wanted in the positions indicated on the deck plan Fig 4). The two pairs amidship should be especially firmly placed. These can be more clearly seen in Blueprint No. 52.

Next month Captain McGinn will tell how to set up the masts and rigging and complete the model.

This Double Cell Shield 1926 greatest improvement



FIG. 1
The King Double Cell Shield
shown in the
with Picture 11
N. A. 111



Every Stage Completely Double Shielded

1. This new King Double Cell Shield is the first that shields the entire radio receiver, including the tuning eye, the volume control, the station selector, the pilot light, and the speaker. Assembled, there is a double wall of copper between each coil. No radio we have ever seen, is so completely shielded. And none of similar capacity gives quite such clear reception and such great selectivity.

Single Dial Station Selector

2. Many receivers claim to operate on single dial. The King 62 and 63 pick up the station with a simple turn of a single knob—without sacrificing selectivity and volume. For distant stations, two verniers are available, one to increase or decrease volume, the other governing selectivity. Weak or distant stations are thus brought in with ease.

Cushioned Tube Mounting

3. Tube socket punches are mounted on flexible phosphor-bronze springs which prevents the familiar "tube noises" caused by mechanical vibration.



Rugged Mechanical Construction

4. Four heavy brackets carry the construction. They are equally spaced and supported by heavy steel and brass strips. Durability is an inbuilt feature.

Pilot Light

5. A small lamp, drawing only one-tenth ampere is used as pilot lamp to illuminate the wave length scale. Beads making readings easy, this pilot light also serves to tell when tubes are on and off. Set may be operated without light.

There is a King Set for Every Radio Taste and Almost Every Purse. Priced from \$65 to \$210. Without Accessories.

KING-BUFFALO, INCORPORATED
For Twenty Years Master Makers of Precision Products
BUFFALO, NEW YORK

The great King radio where King is
made in the U. S. A. and is the
best of the best in the radio industry.

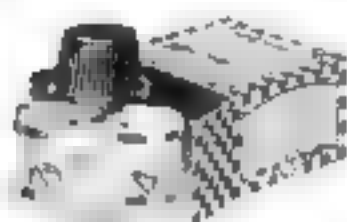
"Most Radio Per Dollar"

KING RADIO

Bradleyohm-E

PERFECT VARIABLE RESISTOR

for B-Eliminators



Bradleyohm-E is a new and enlarged Bradleyohm designed especially for B-Eliminator Voltage Control. The extra long columns of scientifically-treated graphite discs insure perfect voltage control over a wide range. It is made in several ranges for various B-Eliminator circuits.

Bradleyunit-A

PERFECT FIXED RESISTOR



Bradleyunit-A is a solid molded resistor for radio circuits. It is molded and heat-treated under high pressure, making it impervious to moisture. The silver-capped ends can be soldered without affecting the calibration of the Bradleyunit.



Are You Building a B-Eliminator?

IF so, follow the example of leading radio engineers and use the Bradleyohm-E and Bradleyunit-A for your voltage control.

Most of the well-known factory built B-Eliminators are equipped with Bradleyohms as standard equipment. Surely, no better recommendation of the reliability and stability of the Bradleyohm can be asked.

Build permanent performance and high efficiency into your B-Eliminator by asking your dealer for Bradleyohm-E and Bradleyunit-A for your circuit.

Allen-Bradley Co.

293 Greenfield Ave., MILWAUKEE, WIS.

Use
Allen-Bradley
Perfect Radio Devices

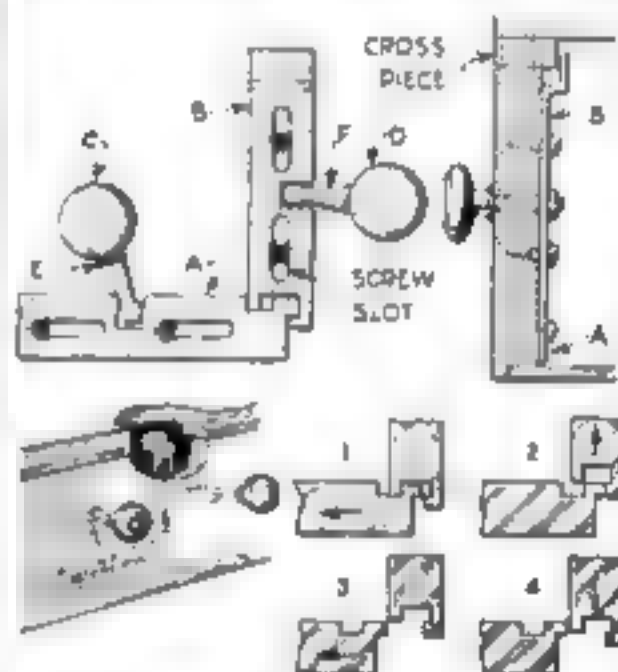
Some Workshop

Curious Combination Lock Installed in a Bureau

By R. H. KASPER

AFTER purchasing an expensive bureau, I wished to attach a lock on one of the drawers without detracting from the appearance, but could not obtain one that would answer the purpose. I then decided to use a secret combination, using the original drawer knobs as dials to operate the lock. Although the arrangement is simple, it would puzzle any meddler or unauthorized person.

The knobs C and D carry on the inside of the drawer front the fingers E and F. Finger E engages a slot in the brass slide A, which is placed horizontally near the



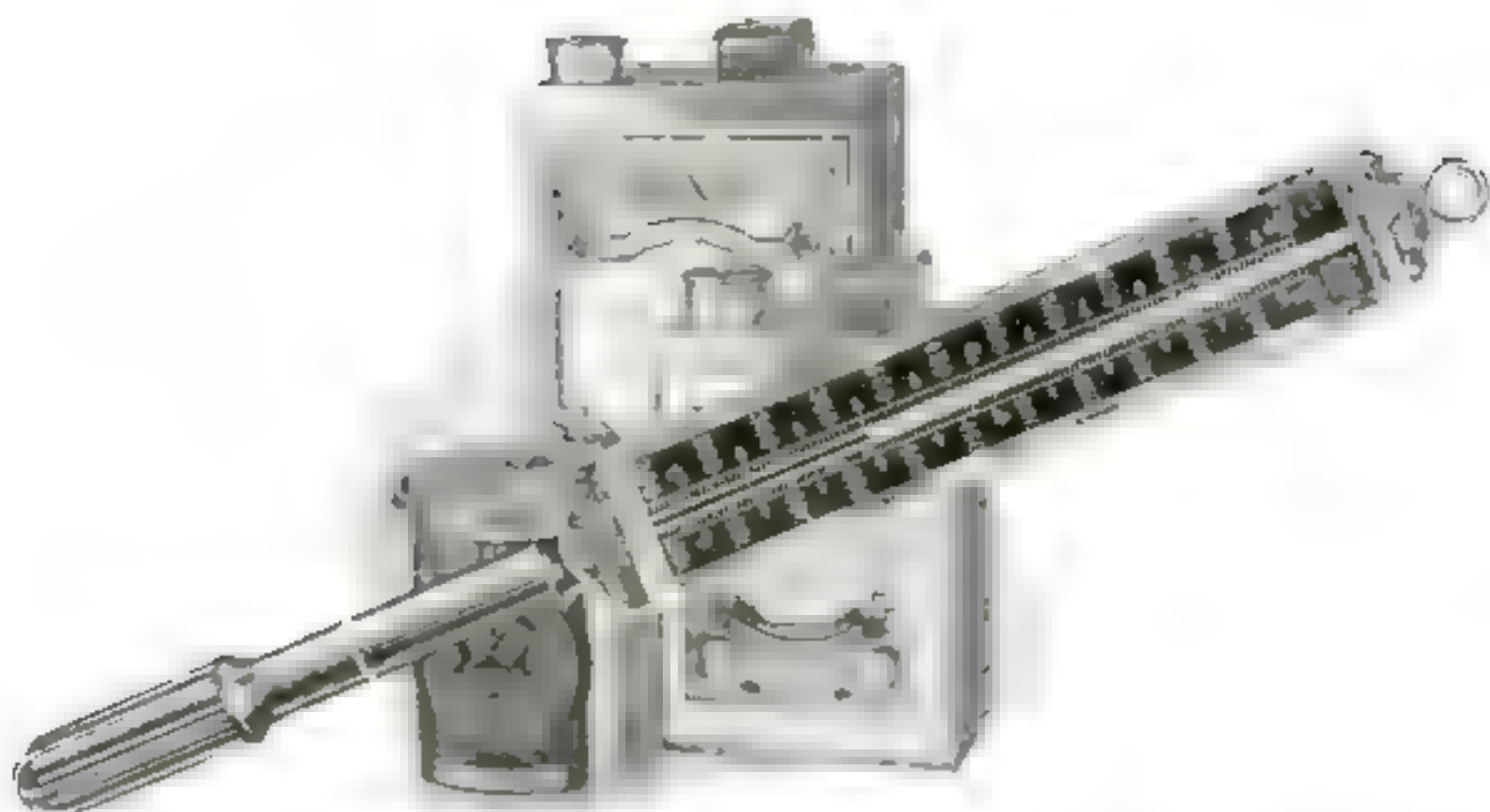
In this secret lock two drawer knobs are used in combination to operate the bolt mechanism.

bottom of the drawer front. Finger F engages a slot in the vertical slide B. Both slides are slotted in two places so that they can be retained loosely in position with wood screws.

Slide B, as shown in the sectional view, is offset to suit the width of the wooden crosspiece above the drawer. The offset portion acts as a lock bolt. In the position shown the drawer is locked.

To open, the knob C is turned to the right, as in No. 1, causing slide A to move a short distance to the left. Knob D then is turned to the right, causing slide B to move upward, as in No. 2. Knob C then is turned again to the right, which causes slide A to clear slide B, as in No. 3. Next, knob D is turned to the left, causing slide B to move in the direction of the arrow so that its upper end no longer engages the crosspiece. This unlocks the drawer. In locking the process is reversed.

AMATEUR furniture makers often are puzzled as to how to finish the interior of drawers. Unless the natural wood is exceptionally dark in color, the drawers should be stained, but the stain should be considerably lighter than that for the outside of the case. The inside of the drawers then should be given a coat or two of flat drying varnish. The outside of the drawers and edges are finished best with a thin coat of shellac over the stain, as varnish may cause the parts to stick.



Tycos Instruments

have been used for 15 years in making
BERRY BROTHERS Varnishes

Says E. G. Richardson, Chief Chemist of Berry Brothers

"The production of high-grade varnish such as our 'Liquid Granite' requires the use of the best materials, and also the exercise of the greatest care to see that each step in the various processes is properly followed.

"Temperature plays an extremely important part throughout. For instance, oil must be brought to a certain temperature and held there for a definite period. If the proper temperature is not reached, the oil will not have sufficient body. If it is exceeded, there is danger of fire.

In cooking a kettle of varnish, the ingredients must be added at just the right moments and at the proper temperatures to insure perfect results. The spoiling of a kettle of varnish is a serious thing, for the materials we work with are expensive.

The use of accurate and dependable temperature indicating devices is therefore an absolute necessity to safeguard the processes and put the responsibility squarely up to the individual workman.

"For 15 years we have used Tycos thermometers on our varnish kettles. These are hung over the sides of the kettles in which the varnish is cooked and give us correct temperature readings at all stages of the cooking.

"These instruments have always performed satisfactorily and we know we can depend on their accuracy. They not only prevent waste of very costly materials, but help us maintain the uniform high quality of our varnishes.

TO MANUFACTURERS

If your manufacturing processes require the indicating, recording or controlling of Temperature, there is a type and style of instruments in the Tycos Line of 8000 varieties that will help you. Informative literature on any type of instrument will be sent you promptly on request, or our engineer will consult with you on the application of Tycos to your particular manufacturing process.

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Tycos - for the Home

Room Office Thermometers
An aid in promoting human efficiency.

Bath Thermometers
To enable you to get the most good from your bath.

Water Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Room Wall Thermometers
To help you maintain a temperature in your home conducive to good health.

Water Quality Compasses
To show you the right way in unfamiliar country.

Room Fever Thermometers
A necessity in every home.

Room Stormguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Room Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, or a postal, for booklets on any of the above.

Tycos - for the Medical Profession



Room Sphygmomanometer, Pocket and Office types.

Room Urinalysis Glassware.

Room Fever Thermometers.

Booklets on request.

THE SIXTH SENSE OF INDUSTRY

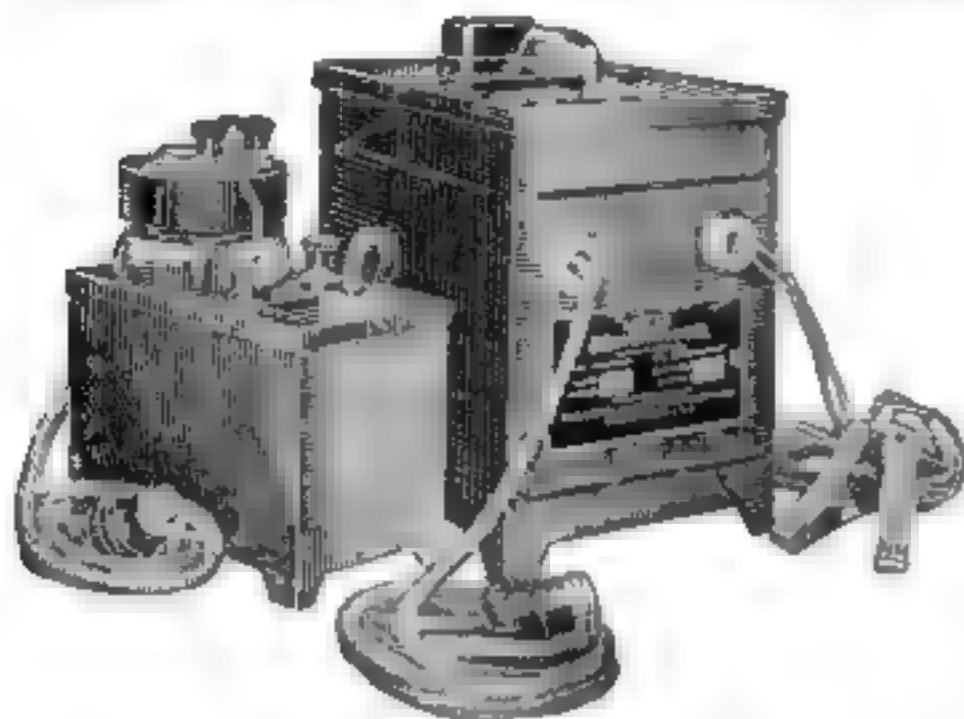
Tycos Temperature Instruments

INDICATING • RECORDING • CONTROLLING



SILITE

TRICKLE CHARGER



Absolutely Noiseless. Makes a power unit of your storage battery!

You can make a power unit of your present storage battery with the new Silite Trickle Charger.

Absolutely noiseless, without bulbs or moving parts, Silite Trickle Charger is left permanently on charge. It replaces at a slow rate the power you use while your set is operating. Silite Trickle Charger may even be used while your set is in operation without hindering enjoyable reception.

No Bulbs—No Adjustments—Can't Wear Out!

Silite is the marvelous new metallizing glass rectifying element discovered and perfected in the Kodak Laboratories. Silite Chargers have no adjustments, no wearing parts—they cannot overheat or damage your battery. Silite Trickle charges at .5 amperes—much faster than other trickle chargers—enough to keep a battery always at top efficiency. Your nearest radio dealer can show you the Silite Trickle Charger.

SILITE HOMCHARGER

Absolutely silent—fast 24-3 ampere charging rate. No bulbs. Can be used while set is in operation. Complete, nothing else to buy . . . \$19.50

SILITE TRICKLE CHARGER

Makes a power unit of your battery. Left permanently on charge keeps a battery always at full efficiency. Absolutely silent—no bulbs. Complete . . . \$10.00

["Behind the Scenes in a Broadcasting Station", an interesting, 24-page booklet, together with literature describing Silite Battery Chargers, will be mailed free on request.]

DEALERS: Write for full information on Silite Chargers and other Kodak Products.

THE KODEL RADIO CORPORATION, 500 EAST PEARL ST.
CINCINNATI, O., U. S. A.
Owners and Operators of Broadcasting Station WKRC

Battery Chargers
Power Units

KODEL

Radio Receivers
Loud Speakers

POWER SPECIALISTS SINCE 1912

At Home Workshop

Latest Ship Model and Radio Blueprints

TWO notable additions are made to our list of blueprints this month. One is a set of three prints, Nos. 51, 52, and 53 in the list below, giving full size drawings of all the parts of a simplified model of the famous American clipper ship, *Sovereign of the Seas*. These blueprints supplement the article by Capt. E. Armitage McCann, which begins on page 65. If you intend to build this magnificent model, you will need all three blueprints.

The other addition is a set of two blueprints, Nos. 54 and 55, which show exactly how to build the incredibly efficient five-tube radio set designed by Alfred P. Lane and described in an article beginning on page 58.

Complete List of Blueprints

ANY ONE of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The editor will be glad to answer any specific questions relative to tools, material or equipment. Blueprint Service Dept.

Popular Science Monthly

250 Fourth Avenue, New York

GENTLEMEN

Send me the blueprint, or blueprints, I have underlined below, for which I enclose

No.	Title	Published	Price
1	Sewing Table	Feb.	25c
2	Smoking Cabinet	Mar.	25c
3	Bed Table	Apr.	25c
4	Kitchen Cabinet	May	25c
5	Shaving Cabinet	June	25c
6	Arbor Gate and Seats	July	25c
7	Porch Swing	Aug.	25c
8	Bench and Tilt Table	Sept.	25c
9	Electric Washer	Oct.	25c
10	Tea Wagon	Nov.	25c
11	Christmas Toys	Dec.	25c
12	Workshop Bench	Jan.	25c
13	Infant Radio Cabinet	Feb.	25c
14	Cedar Chest	Mar.	25c
15	Phone Table and Stool	Apr.	25c
16	Grandfather's Clock	May	25c
17	Flat Top Desk	June	25c
18	Colonial Desk	July	25c
19	Cabinet and Desk	Aug.	25c
20	Pergola Garage	Sept.	25c
21	Gardening Table	Oct.	25c
22	Canoë Sailing Outfit	Nov.	25c
23	Baby's Crib and Pen	Dec.	25c
24	Kitchen Cabinet Table	Jan.	25c
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33	Rush Bottom Chair	Oct.	25c
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35	Sheraton Table	Dec.	25c
36	Salem Chest	Jan.	25c
37	Desk in Sheraton Style	Feb.	25c
38	One Tube Radio Set	Mar.	25c
39	Three Stage Amplifier	Apr.	25c
40	Four Tube Receiver	May	25c
41	Pirate Ship Model—Hull	June	25c
42	Pirate Ship—Details	July	25c
43	Galleon Model—Hull	Aug.	25c
44	Galleon Model—Details	Sept.	25c
45	Sailing Yacht Model	Oct.	25c
46	Brown Cabinet	Nov.	25c
47	Airplane Model Flying	Dec.	25c
48	Copper Ship Model—Hull	Jan.	25c
49	Copper Model—Details	Feb.	25c
50	Copper Model—Rigging	Mar.	25c
51	Five Tube Radio Set	Apr.	25c
52	Five Tube Set—Details	May	25c

Name

Please print name and address very clearly

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City and State

Two with the Strength of SEVENTY



Let those two hands grip the handles of a Porter Bolt Clipper and they have the power of seventy men,—power to cut heavy bolts, rods or chain; power to remove (by splitting), nuts which cannot be turned with a wrench; power to save valuable time, power to cut labor costs; power to make repairs quickly—anywhere.

Porter tools are used all over the world, in factories, in shops, on construction jobs, in mines—wherever labor saving is a factor.

Tools make the man

Write for catalog of Porter Bolt Clippers, Wire Cutters, Chain Cutters and Nut Splitters. Order through jobber or supply house.

PORTER'S *Time Savers*



H.K. PORTER INC. EVERETT, MASS.

The Passing of "By-Pass" condensers



Dubilier Condenser Type 907 Capacities 0.1 to 2.0 mfd. Price \$1.60 to \$1.75

"BY-PASS" was the name originally given to small paper condensers by Dubilier. This name described their functions—such as shunting radio frequency currents around high resistances, and their use in amplifier circuits.

But now the clumsy old "By-Pass" condenser is out of date. The high voltage used in radio today along with sub-panel construction, demand a condenser of higher electrical efficiency and more compact size.

In the new Type 907, Dubilier has made a compact all-purpose condenser with a *working voltage** of 160 volts D.C. With improved soldering lug terminals and mounting feet, Type 907 will give more efficient service in smaller space for every purpose for which the old "By-Pass" type of condenser has been used.

For long life at high voltages insist on Dubilier Paper Condensers.

Dubilier

CONDENSER AND RADIO CORPORATION

*Working voltage means more than "test voltage." It is the voltage at which a condenser may be safely used in continuous operation.

CRYSTAL CLEAR TONES ON ANY SET

IN U. S. A.
\$3.50



Dealers
or
Direct

Carborundum Stabilizing Detector Unit

THERE is no denying the pure true quality of crystal reception.

And you can get such reception on any set without the fuss and worry of a nervous Cat's whisker jumping off the sensitive spot.

The Carborundum Stabilizing Detector Unit has revolutionized crystal detection. Built around the Fixed Permanent Carborundum Detector—no Cat's whisker—no adjustments—retains its sensitivity and simply can not burn out.

The Stabilizer gives you a resistance controlling feature through which the Detector can be made to match the impedance of any circuit. Simply turn the potentiometer knob.

The addition of an ordinary flash light dry cell gives the necessary booster voltage.

For greater sensitivity—greater distance—but above all for the reception of tones of natural quality equip your set with

The Carborundum Stabilizing Detector Unit It improves any set

THE CARBORUNDUM COMPANY
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Hook-Up Book D-6

Carborundum is the Registered Trade Name used by The Carborundum Company for its own products. This Trade Mark is the sole property of The Carborundum Company.

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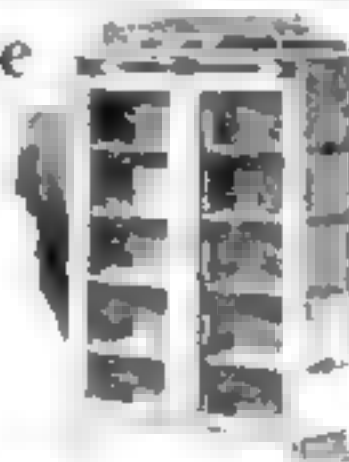
An Easy-to-build Bookcase

IF YOU have not had much experience in woodwork, you will find the bookcase illustrated one of the few really attractive and useful pieces of furniture that you can construct without a single difficult joint. The parts are put together with butt joints such as are used in making common boxes, there is not a dowel, a mortise and tenon, nor a dovetail used in the construction.

The unique methods by which the construction has been simplified are not apparent, however, in the finished bookcase. The design is good and will stand comparison with the better class of bookcases sold in furniture stores.

Blueprint No. 37 of the bookcase will be sent on receipt of 25c

POPULAR SCIENCE MONTHLY, 250 Fourth Ave., NEW YORK



Home Workshop

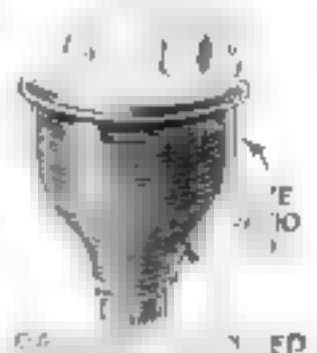
How to Improve a Common Workshop Gas Burner

ONE of the greatest faults of the home constructed gas furnaces so often used for brazing, melting and heat treating is the difficulty experienced in keeping the appliance burning.

As soon as the object undergoing treatment is removed, the flame is blown out almost immediately by the force or speed of the gas.

In most of these furnaces the burner tube is merely a straight piece of pipe. By screwing or otherwise attaching a reducer to the burner end of the burner tube, a perfect high pressure blast will result. It will not blow out.

Any burner thus equipped (together with a part of an ordinary mixer or a common reducer) may be used successfully in any position as a portable blowtorch.—JOHN H. SCHAEFER



Two ways of altering a workshop gas burner

Unique Candlestick

(Continued from page 9)

deep. The back piece is $1\frac{1}{2}$ by $3\frac{1}{2}$ in.

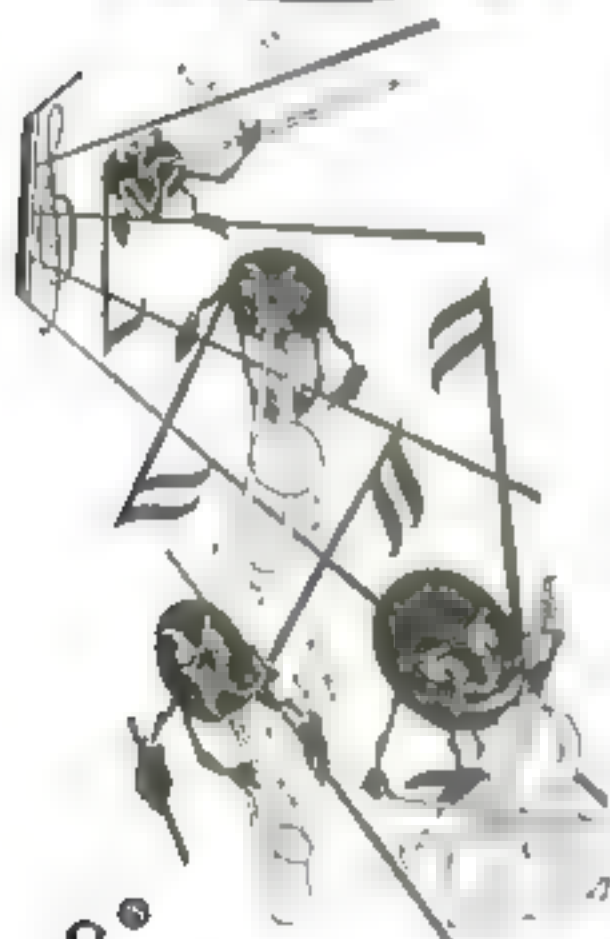
Size all the end grain of joints with a thin coat of liquid glue. When dry, scrape off any lumps, apply glue to the joint parts, and assemble the sides and back with top and bottom. In clamping together, be sure that the assembly is square at every point.

Make the drawer front $\frac{3}{4}$ by $1\frac{1}{2}$ by $3\frac{1}{2}$ in. In the lower edge cut a rabbet $\frac{1}{2}$ in. deep and wide to receive the front edge of the bottom. Lastly rabbet the ends $\frac{1}{2}$ in. deep and $\frac{1}{2}$ in. wide to carry the ends of the drawer sides. These are of $\frac{1}{2}$ -in. stock, the same width as the front and $3\frac{1}{2}$ in. long. Rabbet the lower edges $\frac{1}{2}$ in. wide and $\frac{1}{2}$ in. deep, and the back ends $\frac{1}{2}$ in. wide and $\frac{1}{2}$ in. deep. The drawer back is $\frac{1}{2}$ by $1\frac{1}{2}$ by $3\frac{1}{2}$ in.

Size the end grain of the joints, and glue them when assembling. Nail the front ends of the sides and the ends of the back with $\frac{1}{2}$ -in. brads, and nail in the $\frac{1}{2}$ -in. bottom, which extends under the back.

When the finish is dry, add a neat drawer pad, and line the drawer with velvet.

If the candlestick shaft is to be turned, use 3-in. square stock cut $10\frac{1}{2}$ in. long. If no lathe is available, a good looking shaft can be made with a square section, the four sides being shaped by saw kirting to the necessary depth and trimming with chisel, spokeshave and wood rasp.—E. L.



Every note of every instrument—clear as a bell

That is what an Aero B Amplipower will do for your radio set. You will actually hear the deep resonant base that is essential to real music—notes that have been "starved" in radio reception.

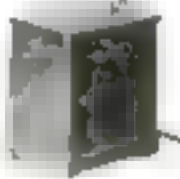
With an Aero B Amplipower, the tone of your set will be as much better as the tone quality of the new talking machine is better than that of the old.



The Amplipower supplies all the "B" current for the set, eliminating "B" batteries, and in addition, has the built-in high voltage power tube that increases volume and improves the tone quality. Can be attached to any set in a few minutes in the same manner as "B" batteries without changes in wiring. Price \$65.00 without tubes.

Aero B is also built as a "B" power unit without the high voltage power tube. Price \$35.00 complete.

THE GLENN L. MARTIN COMPANY
Radio Division Cleveland, Ohio



Make Your Own

A Sand Table to Keep the Children Happy

YOUNG children get more lasting enjoyment out of playing in a pile of sand than in almost any other activity. A sand table, such as the one illustrated, gives them a chance to amuse themselves in this way to their heart's content. This table is particularly strong and neat, yet so simple that the home mechanic should have no trouble in making it. The addition of a hinged top makes the table, when needed, useful for other purposes.

First glue up stock for the top (leaves 1 and 8 on the following page) and

Cut two pieces of 1 by 12 in. stock 4 ft. 1 in. long for the top and plan the edges straight. As 12 in. stock is always a trifle narrower than 12 in., glue and nail to one edge of each a strip sufficiently wide to give a finished width to the boards of 12 in. Smooth the joints flush and sandpaper enough to work the dust into the glue, hiding the joint.

Glue up the bottom, using three widths of 1 by 8 in. pine, and finishing the width



When the children are through playing, the top is closed and the table put to other uses.

with a narrow strip glued and nailed. Drive three 2 in. corrugated fasteners into each joint from the underside and set the piece aside to dry.

Cut the 2 ft. 2 in. legs from 3 by 4 in. stock, and square them to a net width of 2 1/2 in. Choose the two best sides to go outside, and mark the others with an X to use as face or working sides. Measure down from the upper end of one leg 2 1/2 in. and square around the stick, holding the square handle against the face sides. Trace a line on each outside face 1 1/4 in. from the opposite working face, and rip down, saving in the waste wood. Cut off the 3/4 in. blocks so formed, making the tenon shown in Fig. 2.

Lay out 3/4 in. below the shoulder on each working side for a mortise 3/4 in. wide and 1 1/4 in. long, centering on the side. Cut these mortises to a depth of 1 1/4 in. by chiseling across the grain with a 3/4 in. chisel, or by boring holes and then trimming smooth.

Lay off the other three legs with the first as a pattern, being careful to make the set in two pairs.

For the rails, cut two 1 by 12 in.



A tiled bath or kitchen— at about 1/10th the cost

GLISTENING white! Waterproofed! Easily cleaned!

Now every home can afford a snow-white, sanitary bathroom or kitchen.

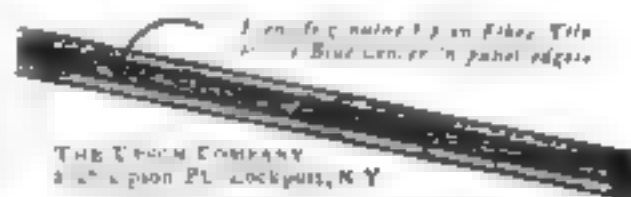
Use Upson Fibre-Tile. Apply the big, room-length panels right over the old wainscoting or direct to the old plaster. Properly applied, they should never warp or bulge.

Then enamel the surface, cover the joints with wood trim, and your bath or kitchen has the porcelain-like finish of expensive ceramic tile, at a cost within your reach.

Do not confuse Upson Fibre-Tile with other tile boards. Its tile indentations are permanent. And because the surface is smooth, not lumpy like substitutes. Upson Fibre-Tile saves one or more coats of enamel. Comes in two patterns—square and oblong.

Try Upson Fibre-Tile on your kitchen or bathroom. Its record shows it a proved success in thousands of buildings. You'll like it. We'll write you for samples and price book.

UPSON BOARD



THE UPSON COMPANY
225 E. 1st St., Lockport, N.Y.

For need find ten cents for finished samples of UPSON BOARD and UPSON Fibre-Tile, and for blue print.

Box of ten.

NAME

ADDRESS



*"They last twice as long as
the smaller Batteries
of equal voltage"*

"THAT'S a pretty broad statement, Tom. Won't you have to make it conditional on the number of tubes in the set or the use of the new power tubes?"

"No, sir! Under the same operating conditions—whether you use four, five tubes or more, whether you use a power tube that uses up to 135 volts, the Eveready Heavy-Duty No. 770 or the even longer-lived Eveready Laverbilt No. 486 will last twice as long as the smaller sized 45-volt batteries."

"Well, they ought to, they cost more."

"Yes, about a third more—but lasting twice as long, they cost much less."

"Your arithmetic is good, Tom, but if that's so, when I bought my set why did the dealer equip it with the smaller Eveready 772's? Why didn't he put in the Eveready Heavy-Duty Batteries?"

"He probably thought he was doing

you a favor—making your first investment cost you a little less. That little difference looks like a lot to a good many folks who are buying their first set, equipped with tubes, loud speaker, 'A' and 'B' batteries and everything."

Heavy-Duty batteries last twice as long as the smaller batteries of equal voltage. Eveready Heavy-Duty Batteries are the great contribution that the world's foremost electro-chemical

laboratories has made in "B" battery economy, dependability and satisfaction.

Dry "B" batteries give a noiseless current, pure D. C. (direct current), the kind that is essential if you prize pure tone.

Send for booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you upon request. This booklet also tells about the proper battery equipment for use with the new power tubes. There's an Eveready dealer nearby.

Manufactured and guaranteed by
NATIONAL CARBON CO., Inc.
New York San Francisco

Canadian National Carbon Co., Limited
Toronto, Ontario

Tuesday night means Eveready Hour—
9 P. M., Eastern Standard Time, through
stations

WEAF—New York	WLAS—Chicago
WJAB—Providence	WYAS—Cleveland
WET—Boston	WVJ—Detroit
WTAG—Cincinnati	WGN—Chicago
WEE—Philadelphia	WOC—Davenport
WGB—Buffalo	WCCO—Minneapolis
WJAT—Pittsburgh	WEE—St. Paul
	WSD—St. Louis

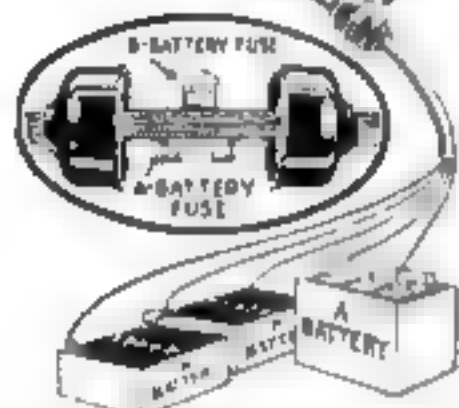


EVEREADY
Radio Batteries
—they last longer

NOTE: A "C" battery gives a quality of reception unobtainable without it and greatly increases the life of your "B" batteries.



A Safety Valve for Your Radio



SUPPOSE the battery wires to your radio set became crossed, accidentally, what would happen? Almost anything from a serious fire, due to overheated wires, to a ruined B-battery or a burned-out tube. The consequences are serious enough to warrant some careful thought, right now!

The cheapest insurance against the dangers of crossed wires is to protect your radio set with a Belden Fused Radio Battery Cord. It provides

- 1—An A-battery fuse.
- 2—A B-battery fuse.
- 3—A polished bakelite cover for the battery fuses.
- 4—A compact connecting cable that duplicates with loose wires.
- 5—A color-code on each wire for identifying each circuit.
- 6—A time-saver, because the cord is quickly connected and easily concealed.

Eliminate fire hazard, ruined or discharged batteries, and burned-out tubes. Ask your nearest dealer for a Belden Fused Radio Battery Cord, to-day!

Belden Manufacturing Company
2304A S. Western Avenue, Chicago, Ill.

Use a Belden Fused Radio Battery Cord

The Home Workshop

A Sand Table

(Continued from page 58)

smooth up and plane to a width of $2\frac{1}{4}$ in. two pieces of 1 by 3 in. stock, 3 ft. $10\frac{1}{2}$ in. long (Fig. 9), and two pieces 1 ft. $10\frac{1}{2}$ in. long (Fig. 3). Miter and notch as shown.

In the center of the long rails (Fig. 9) cut dashes $\frac{3}{4}$ in. wide and $\frac{1}{4}$ in. deep to receive the ends of the center rail, which is 1 ft. $9\frac{1}{2}$ in. long. See Figs. 1 and 4.

Assemble the rails and the legs, applying the glue to both tenons and mortises and clamp them together. The outside size should be 2 by 4 ft. Square up and set aside to dry.

Square up the bottom (Fig. 5) and notch each corner. Slip it into place be-

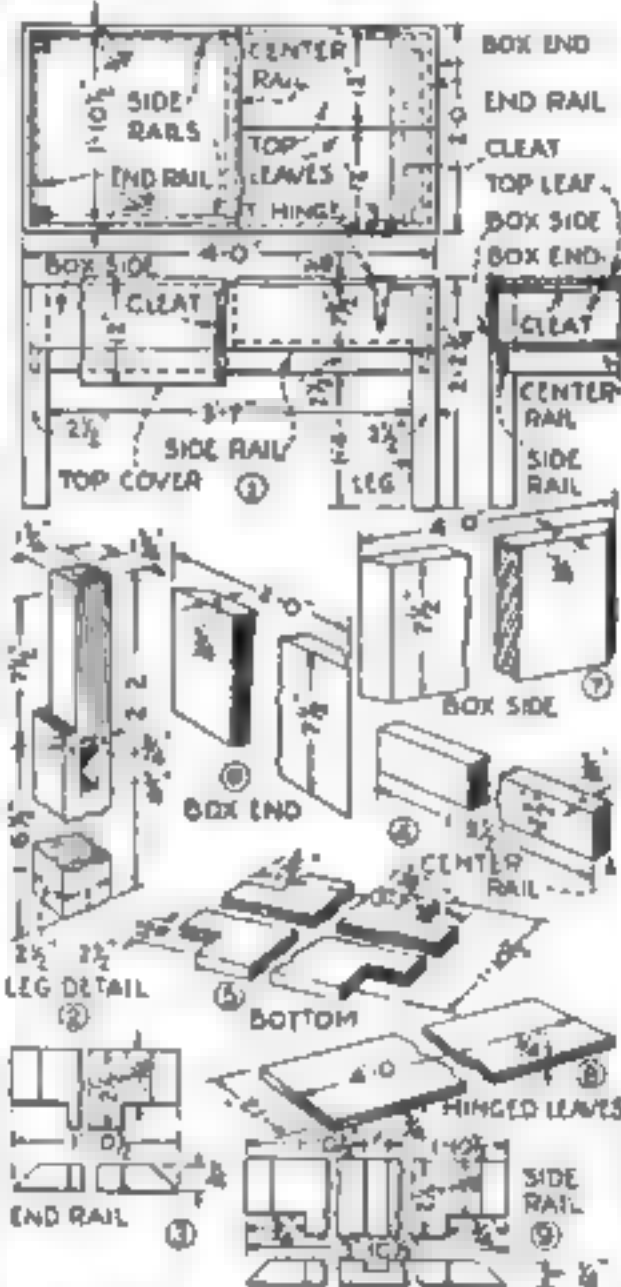


Fig. 1 shows the top, front and part of the end view; Figs. 2 to 9 give the working details.

tween the legs, so that it rests on the rails, and nail through the face into the edges with sixpenny finishing nails.

Now make the box sides and ends (Figs. 6 and 7) of 1 by 8 in. stock. Miter and fit around the leg notches and nail to the legs and bottom with sixpenny finishing nails. Nail the miters with fourpenny finishing nails.

Attach the top boards to the side rails with steel T-hinges, notching the wide sides into the top pieces. To prevent the top from warping, screw three cleats 11 in. long to each top board.

The table may be finished to match the woodwork of the room, or simply oiled with boiled linseed oil. Half fill the box with sand.—EDWIN M. LOVE.

The One Time Machines Behave

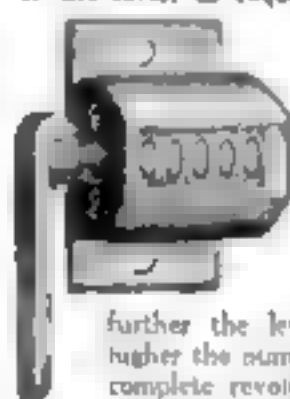
What machine is so well designed that it always behaves without watching?

The nearest approach to such a machine is the one equipped with a Counter. The moment there's any "acting up," it shows on the record of the Counter.

Without standing over the job yourself, you can make the best-time record of output the ALL-time record—with the aid of a

Veeder

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording



the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the Counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. Price, \$2.00.

The "Form UM" Magnetic Counter below counts operations or units of output from any distance that wires connect with machines.



Mechanical contacts on your machine make and break the electrical circuit which operates the counter. The electro-magnetic drive can get its current from your regular lighting circuit Direct Current, (110 volts) or from storage battery.

Write us about that counting problem of yours—it's probably solved in the big Veeder booklet; copy free.

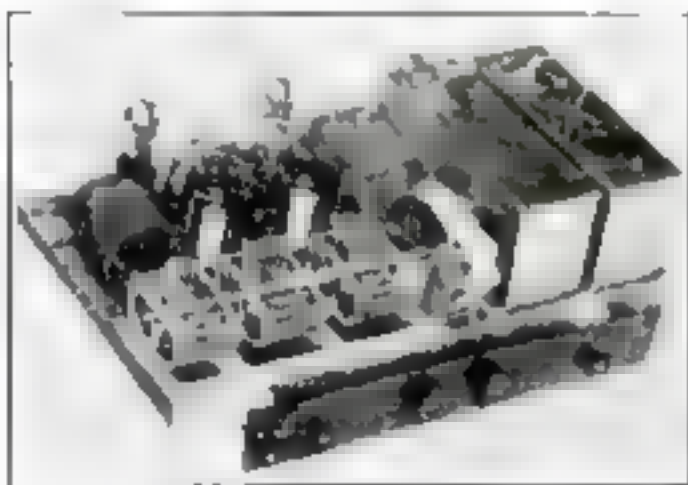
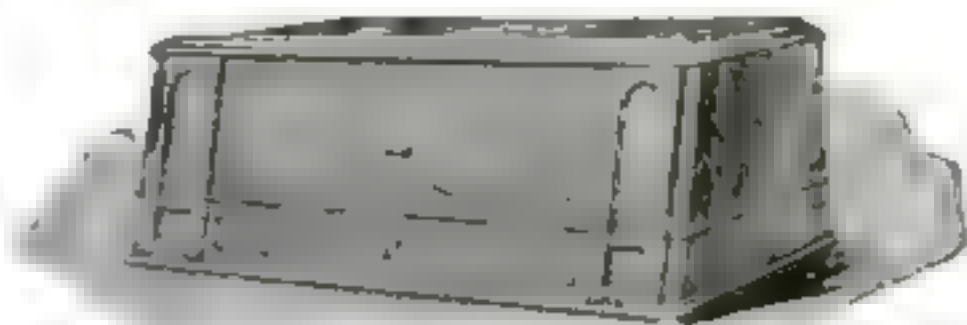
The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

**Premier
Quality**

THOROUGHBREDS— with a past history that indicates what you may expect now.

NO ONE challenges the statement that B-T has always produced Radio products that have been more than ordinarily successful. We therefore believe that POPULAR SCIENCE readers will be interested when B-T announces a "permanent model receiver."

The COUNTERPHASE-EIGHT and the new COUNTERPHASE-SIX are the supreme efforts of the B-T Company. The engineering skill, unusual designing and manufacturing ability for which B-T are known are more apparent than ever before.



Counterphase-Eight Chassis

A New Idea of Selectivity

Those familiar with the selectivity of the NAMELESS and original COUNTERPHASE will be astounded at the statement that B-T believes the new COUNTERPHASE the most selective set ever built. A feature entirely new in radio and exclusively B-T is largely responsible for the added degree of selectivity—THE REJECTOR STAGE.

Straight-Line-Selectivity condensers, designed expressly for these receivers tune the five stages with ONE CONTROL.

The *Station Indicator* employs B-T patented ideas not found elsewhere that permit absolutely accurate calibration of each receiver. You will instantly appreciate the simplicity of this new device.

Simplicity of tuning is the keynote—one station selector—no manual oscillation control—yet the new COUNTERPHASE is sensitive across the full scale.

Those who have examined these new models say they "run true to form."

It is not possible here to paint an adequate word picture of what you will find in these new Receivers. Go to an Authorized Dealer and ask for a demonstration. If that is not convenient, send for a copy of *BETTER TUNING*, 12th edition. In it we frankly discuss the merits of the new COUNTERPHASE. You will also find a discussion on the various types of B-Power Units.

If at all interested in radio you cannot afford not to know about these new products. The coupon is for your convenience.

Counterphase Receivers are not sold in kits but as complete sets only.

Please send the 10th edition "Better Tuning" for which I enclose one Litera in Counterphase Receivers. Litera on Parts of B-Power Units.

Name _____

Address _____

I am dealer and interested in securing exclusive territorial rights in Counterphase Receivers check here and attach to your letterhead. ☐ No to

**Premier
Quality**

Manufacturing Co.

526 S. Canal St. Chicago, Ill.



B-POWER UNIT

There is no radio product in which the user must place more confidence in the manufacturer than in a B-Power Unit.

This product is designed to deliver dependable B current. There are no knobs to turn and the voltage delivered is always known. Output is sufficient for multi-tube sets including power tube. It's different and we believe better—

Not sold in kit form

Lower Your Radio Upkeep—with UNITRON DEVICES

More power at lower cost—better volume yet clearer tone—these are the virtues you own when you have Unitron Radio Power. In radio the Unitron name is only a few years old, but industrial service has known their good repute for years.

There is among the ten Unitron current rectifiers, one that is perfectly what you want for your particular set. All are economical—money savers. And any one will give you better radio, proved at the speaker, than ever you had before.

This is the Unitron Trickle—\$12.

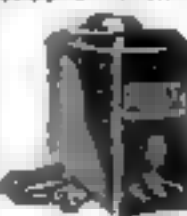
An unusual electrolytic "A" trickle charger—with three distinct charging speeds, controlled by three-way switch. Thus the small or large battery can have exactly its current needs. Permanently connected to battery, can be turned off or on by use of the single switch, or can be kept charging continuously.



Rectifying elements guaranteed two years and will last a lifetime. Simple. Can't overcharge. Current cost 10 of a cent per hour when battery is charging. Mahogany Duo finished case, 9" x 3 1/2" x 6 1/2" high.

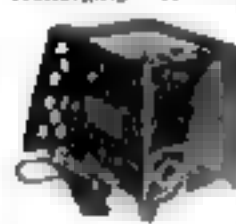
This is the Unitron No-Bee No. 90—\$30.

For sets using up to 90 volts—the ideal light-sucker. B+ power. Voltage up to 450 or detector circuit, and up to 90 for amplifiers at 25 milliamperes. Equipped with new Unitron Electrolytic Tube which is guaranteed for two years and lasts many more. No hum or power distortion is possible. Connect the No-Bee the same as batteries and forget it. Can run down, economical, costs only 1-10 of a cent an hour to run. Mahogany Duo finished case, size 9" x 3 1/2" x 6 1/2" high. B.C.A. 1X21 Tube can also be used.



This is the Unitron Charger No. 0—\$28.

For overnight recharging of radio or automobile batteries subjected to heavy drain, this rectifier has a stout Regal. Charging rate ampere. A two-way switch permits also recharging wet B+ batteries of up to 100 volts, using same charging clips. Equipped with Tunstall No. 4046 or Rectigon No. 105414 Tube, which is guaranteed to serve 1000 burning hours. Charge tapers down as the battery regains full strength. Economical. Noiseless. Can be permanently connected to the set. Housed in Duo Mahogany finish—case 8 1/2" x 6 1/2" x 9 1/2" high.



UNITRON

RADIO POWER DEVICES

Send this Coupon for Details About the Various UNITRONS

FOREST ELECTRIC COMPANY
New and Wilsey Streets, Newark, New Jersey

☐ Please mail me literature that tells about the ten Unitron Radio Power Devices, and how little it will cost to equip my set, which is

a. _____ tube _____ wiring _____ batteries _____

Name _____

Address _____

City _____ State _____

Check here ☐ If a dealer, and write your firm name below

Home Workshop

Stenciling Is Easy

(Continued from page 66)

furnish wall elevations (Fig. 3) showing suitable stencils and color treatment for painted wall decoration in both plain color and stippled effects. There are, however, some fundamental principles which should be observed.

The size of the border should correspond to the proportions of the room. Smaller designs should be used in small rooms, also in low ceilinged rooms. Larger designs are better in larger rooms and ones with high ceilings. In some cases the space between molding and top of windows and doors will not permit the use of a deep stencil. Brighter colors are generally more desirable in smaller designs than in the large ones.

"The pattern should conform somewhat to the character of the room. For instance, the more conventional designs are especially adapted to rooms that are constructed and furnished along a severe style, while the more floral patterns are suited to rooms where the other features give a suggestion of beauty of line.

I POINTED out that motifs suitable for every room and for any decorative scheme may be obtained in stencils, and of course, many people cut their own, which is not hard to do. Prepared cardboard for making stencils can be bought.

Hand shading also is sometimes done, especially in leaves and flowers. Outline stencils are used occasionally. In these only the outlines of the design are stenciled on the wall. When dry, the outlines are filled in with soft brushes of varying widths and often a cloth is used to stipple the design lightly. This takes off surplus color and removes brush marks. Certain spots sometimes are poked off by wiping with a cloth held over the finger, after the color has commenced to set, to produce what are called high lights.

The example shown in Fig. 3 is an effective combination of sponge stippling, which was described in the August issue of POPULAR SCIENCE MONTHLY, and stenciling. The wall is silver gray foundation color sponge stippled first with sage green and sky blue in equal parts, and second with silver gray, one part, and ivory white two parts. The first stencil color is white tinted with olive lake, the second is white tinted with chrome yellow medium. The ceiling is ivory white and the woodwork, that is, the trim around doors and windows, the baseboard and the picture molding is extra dark mahogany.

Fun for Everyone

THE MOST fascinating game of the year has just been discovered. The November issue of POPULAR SCIENCE MONTHLY will tell you how to play it. It's simpler than crosswords, but fully as alluring. It's scientific too, and there'll be prizes.

FREE

140-page Book full of life-size ruled forms, each one completely filled in. The answer to problems of accounting and record keeping for any business or profession. Send for this FREE Book today.

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Ask about the New MOORE'S VISIBLE RECORDS

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Ship Model Making

How to Make Worth While Models of Decorative Ships

By CAPTAIN E. ARMITAGE McCANN

A practical book which tells how any handy person can make models of a Picturesque Barbary Pirate Felucca and a Beautiful Spanish Treasure Galleon.

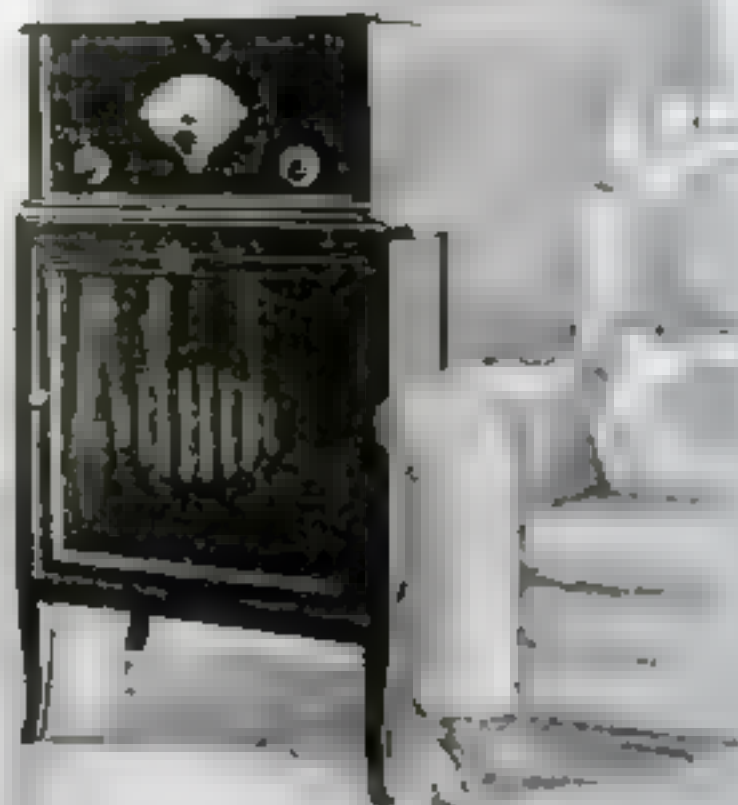
Ship Model Making gives full-sized drawings of every part required. This book describes how to make the models, what materials to use, how to fasten together and color them, how to make the spars and rig the ships. You do not need to know ships to make these models, the book describes everything in detail, but you may use your ingenuity and artistic sense in decorating and can make them larger or smaller than the scale given.

Profusely illustrated—Scale drawings

Price, \$2.50

POPULAR SCIENCE MONTHLY

250 Fourth Ave., New York City



Model Ten \$110.00
 With table, as shown, 147.50
 (Ten per cent higher west
 of the Rockies)



With a FERGUSON you can identify each instrument. You hear each note—treble and bass. The harmony, the "fullness", of the whole orchestra leaves nothing to your imagination.

THE program of your choice, in an instant, by means of one tuning control—calibrated in meters! Surpassing fidelity of tone, through a powerful 3-stage amplifier, of advanced design, that gives you the true "expression" of a distant artist. Marked selectivity, due to complete shielding. These are yours with a FERGUSON. See, hear and compare in appearance, in performance!

J. B. FERGUSON, Inc.
 225 West 57th Street, New York, N.Y.

No Seasonal Models
 Continually Developing Refinements

Ferguson
 The Gold Standard of Radio Receivers

The Home Workshop

Flexible Motor Coupling Made with Inner Tubes

A FLEXIBLE coupling often will add greatly to the usefulness of a fractional horsepower electric motor in the home and home workshop.

To make a coupling of this kind requires only two hardwood flanges and a short length of discarded inner tube. The flanges are turned so that the largest diameter will fit snugly inside a piece of



A small motor and generator connected with a coupling that compensates for misalignment.

3 or 3½ in. inner tube. One is drilled to fit the motor shaft and the other to fit the shaft of the driven machine.

The rubber is tacked to the flanges, which are fastened to the shafts with set screws. Discrepancies in horizontal and vertical alignment are compensated for without lost motion or backlash.

The home mechanic who developed this coupling uses it to connect a one-quarter horsepower washing machine motor to a small generator and to connect the motor to the countershaft of a bench lathe. Many other uses will suggest themselves.—HAROLD N. WHITMORE.

Amazing Block Puzzles

(Continued from page 74)

hands are needed, especially if the blocks do not fit tightly together.

Two more F's are taken with an E at the farther end and inserted at the rear in the upper slots formed by the four G's (Fig. 4 at top). Another G is placed opposite the E, as was done before.

If it is desired to build the puzzle around the one of six blocks, now is the time to insert the latter. It should be in the position shown in Fig. 5; that is, the length of the upper end should be at right angles to the upright G's.

Two E's next are placed in the inside cuts of the F's. One is shown in place in Fig. 4 at the bottom. The other occupies a similar position at the top. The inserted six-block puzzle is not shown in this figure (4), but the two E's will hold the six-block puzzle rigidly in place, if it is to be used.

Four G's are now fitted and bound with two more G's in exactly the same manner as was done previously. Nothing remains but to insert the A blocks, of which there are four.

For this puzzle accuracy is required in making the cuts. If measurements are taken from the center of the blocks instead of the ends it will avoid the trouble that may arise from variations in length.

Those who love to whittle and exercise their ingenuity can find an almost endless number of ways to combine the blocks in this form.

That well-groomed look

Professional men and successful business men—doctors, bankers, lawyers—know that a clean, fresh, well-groomed appearance is an immeasurable asset.

This unique creation, Palmolive After Shaving Talc, gives that fresh, clean look you want. It removes after-shave "stune." And yet leaves no "powdered" look.

It is a powder for men, providing features unknown before.



Personal—to all Palmolive Shaving Cream users

We have prepared a new-type talc for you that ends all shine without that powdered look—Now, accept a can of this unique creation—just send coupon

GENTLEMEN

We have developed a new-type talc for you.

A talc that takes all that after shave shine away, yet that's invisible on the face.

A talc that meets the desires of gentlemen in providing the well-groomed appearance they want, without the "powdered" look that followed old-time talcs.



Used after shaving, all shine goes—yet no trace of powder shows.

Now as a favor to us, please accept a two-weeks trial can to test. Just mail the coupon below. Let us show you what we have done.

A new-principle creation

We are experts in skin care, as you know. We make Palmolive Soap, the leading toilet soap of the world. Palmolive Shaving Cream—the most amazing success in its field—is another of our creations.

Palmolive After Shaving Talc is different from any preparation of like purpose you have ever tried. It is based on scientific findings. It is the result of long experiment in the noted Palmolive laboratories.

Before offering it to you, we spent some years in perfecting it.

Also 10-day tube of Palmolive Shaving Cream

The unique creation that's winning thousands away from old-time shaving soaps—corrects five mistakes of ordinary shaving preparations for you. Send the coupon.

We tried scores of formulas, tried scores of powder blends, tried colors without number to find one that would smooth the face, yet not show a trace of powder.

We consulted skin specialists on what was best for the skin. Then in collaboration with them, perfected this scientific creation providing two unique features unknown before, we believe, in either talc or powder.

First. It is invisible. Men don't like powder to show. Second. It is a scientific counterbalance of skin roughness—keeps the skin smooth and soft.



USE always before an evening or before a dance—wherever an appearance of fresh grooming is important.

On the market but a short while thousands of men to whom good grooming is essential are making its use a twice a day habit—after shaving in the morning before dinner in the evening.

We believe it will delight you. Send us the coupon. Do it now. We'll send you a can of this talc, also a 10-day tube of Palmolive Shaving Cream.

TRY IT—FREE

and a 10-day tube of Palmolive Shaving Cream

Simply mail your name and address and mail to: Dept. 46, The Palmolive Company, De. Carr., Chicago 11.

Residents of Wisconsin should address The Palmolive Company, Wis. Corp., Milwaukee, Wis.

Please print your name and address, briefly.

PALMOLIVE AFTER SHAVING TALC

The Home Workshop

Amusing "Potluck" Game Played with Balls



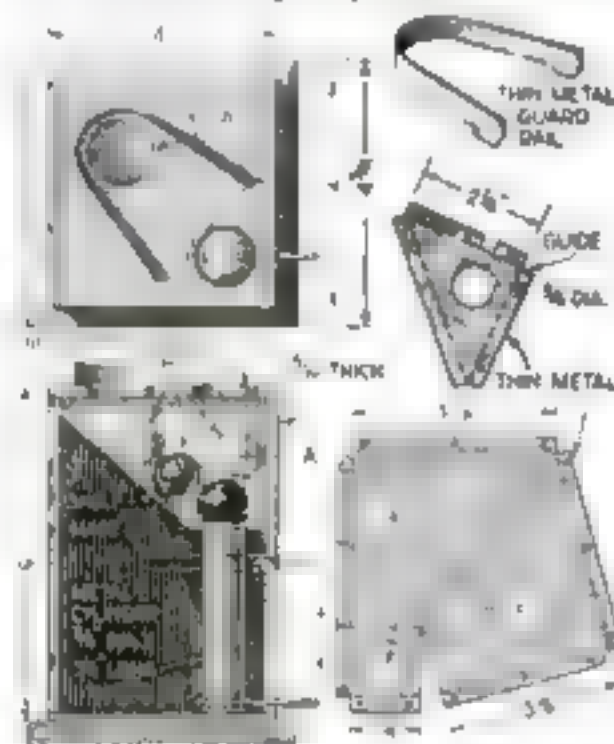
Raising the handle causes a ball to appear. Its color determines what to add to the score.

"POTLUCK," a word that suggests the dipping out of a dish of stew from a kettle—there may be a chunk of meat in the dipper and then again, there may not—would be a good name for this game of chance. No one knows which ball will come in view when the handle is raised.

To play the game, lift the handle up as far as it will go, note the color of the ball, push the ball back through the larger opening, and release the handle.

The red ball counts 15, the blue, 10, the yellow, 5, the black, 1 and the white, nothing. If a ball lodges in the position marked A it can be pushed back by hand.

The construction of the game is made clear in the drawings. The case is merely a wooden box 4 by 4 by 3½ in. inside. A



Top view and a section through the game box; the patterns for the hopper, guide, and guardrail.

metal hopper, which is cut to the pattern shown, is fastened in the upper section. A sliding metal cylinder ¾ in. in diameter and 3¼ in. long is inserted, as indicated for raising a ball into view. Note how the cylinder passes up and down through a thin metal guide.

The balls, which may be of wood or any other hard substance, should be 1 in. in diameter. —DONALD W. CLARK.

TRADE

YALE

MARK

saves your property
from becoming



Burglary insurance may reimburse you in cash. But it will not return the cherished valuables that money cannot replace. Adequate protection—YALE protection—will prevent your property from becoming loot.

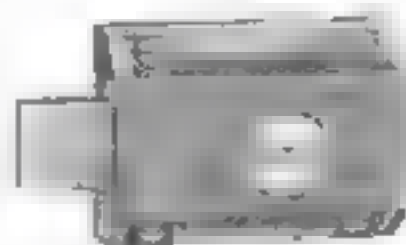
The Yale No. 192 Rotary Bolt Deadlock, the Yale No. 10 Steel Bar Deadlock, the Yale No. 44

Automatic Deadlatch—all are physically able to outmatch the housebreaker—all are cannily designed, sturdily built, shock-resisting guardians of life and property.

Goto your dealer. Select one of these Yale Locks and enjoy proper protection. Send for booklet, "Yale Guards Your Treasures."

The Yale & Towne Mfg. Co., Stamford, Conn., U. S. A.

Canadian Branch at St. Catharines, Ont.

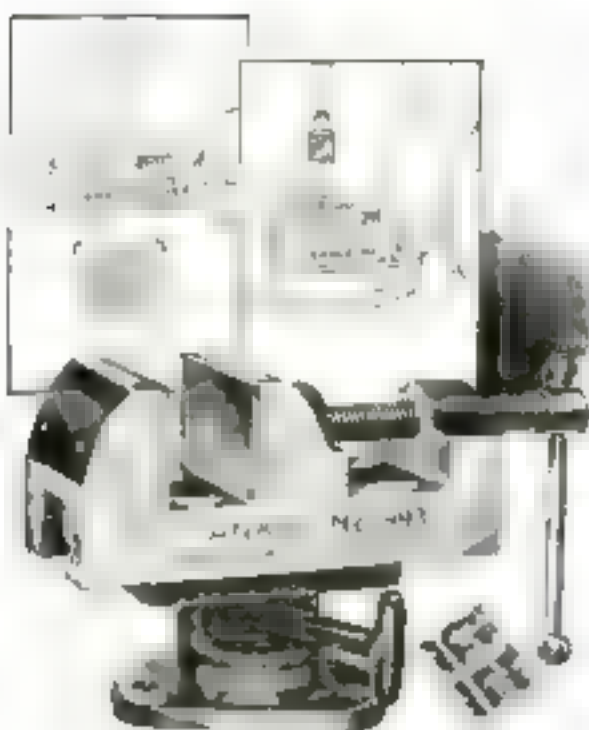


No. 10 Deadlock



No. 192 Deadlock

YALE MARKED IS YALE MADE



The body of the "Yankee" vise, with the work as it is carried to the drill press. Hardwood steel block with V shaped grooves, holds round or irregular shapes.

This means Accuracy and Faster Work

You buy and use "Yankee" Tools because they are different—and will work in ways and places in which no other tools will work.

The "Yankee" Vise is detachable from its base.

Sides, end, top and bottom, and the sliding jaw, are accurately machined to hold work square—with vise flat, on sides, or on end.

For many operations the "Yankee" Vise can be used as a jig. From machine to machine it goes—the work kept in original alignment. You can get the size most convenient for your work.

No. 1994—Jaws open 4 in.

No. 1993—Jaws open 3 3/8 in.

No. 1992—Jaws open 1 1/4 in.

No. 1991—Jaws open 1 1/2 in.

The "Yankee" Vise has swivel base. Cam-throw lever locks vise in any position.

Some Other "Yankee" Tools

Ratchet Bl. Brakes, Ratchet Break Hand, Chain and Bench Drills, Ratchet Tap Wrenches, Spiral and Ratchet Screw Drivers, Plus Screw-drivers, Automatic Push Drills.

Dealers everywhere sell "Yankee" Tools.



"Yankee" on the tool you buy means the utmost in quality, efficiency and durability.

FREE New "Yankee" Tool Book

This interesting little book is for all lovers of true tools. It tells just what you want to know about all the famous "Yankee" Tools. Write for your copy today.

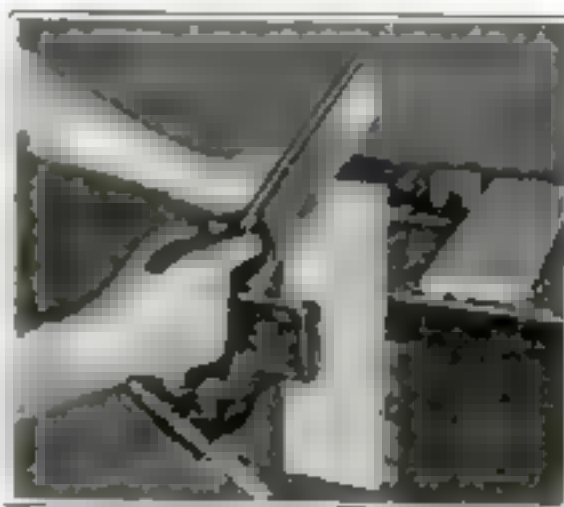
NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE" TOOLS

Make Better Mechanics

Dovetail Joints

(Continued from page 76)

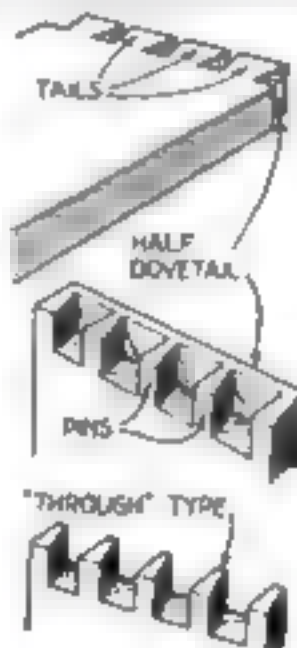


7 Saw down on the line at an angle; the wood between the pins then can be carefully removed with a chisel.

perienced mechanic often lays out the tails by eye. He takes care, if doing fine work, to make the pins much narrower than the tails. This distinguishes a hand-made dovetail from the much coarser and commoner machine dovetail, in which the pins and tails are the same width.

The illustrations (1 to 8), show how to make a half dovetail. Substantially the same process can be followed in making a through dovetail joint, except for the preliminary laying out. The accompanying drawing clearly shows the difference between the two types.

The paged line at the end of the drawer front referred to in Fig. 2 may be from 1/4 to 1/2 in. in from the front face. This lap is shown in the middle of the three drawings; compare with Figs. 1, 2 and 3.



Good proportions for multiple dovetail are essential



8 Properly made, the joint may be pressed together by hand. Apply a little glue before assembling it.



A perfect patch

Makes cracked walls look like new

WHEN you fill a crack or hole with Rutland Patching Plaster, you can paint or paper over it without shellac-ing. The patch will not "spot through."

You can do such a perfect job that the wall looks as good as new, and the patch is as lasting as the wall itself.

It will not crack, crumble or fall out. It will not shrink as plaster of paris shrinks.

Rutland Patching Plaster is easy to use. Comes in handy cans, ready to use. Just add water and apply.

Paint, wall-paper, and hardware stores sell it. If your dealer hasn't it, mail coupon for 1 1/2 lb. carton. Pay the postman 30 cents plus postage. Rutland Fire Clay Co., Dept. R5, Rutland, Vermont.

Other Uses

Mending stucco or cement walls

Pointing brick work

As a mortar to hold loose tiles in bathroom walls or floors



Rutland Patching Plaster

RUTLAND FIRE CLAY CO.
Dept. R5, Rutland, Vermont.
Send me 2 1/2 lb. carton of Rutland Patching Plaster.

Name

Address

My dealer's name

Bradleyometer

THE PERFECT POTENTIOMETER

Uses graphic disc resistors which are noiseless and not affected by atmospheric conditions. Metal parts are nickel plated. One hole mounting. Finish and knob match Bradleystat. Made in 200 and 400 ohm ratings.



Allen Bradley Co. ®

Electric Controlling Apparatus

291 Greenfield Avenue Milwaukee, Wis.

The Home Workshop

Tricks You Need to Know When Inclosing an Open Porch

By A. E. ELLING

IF YOUR house has an open front porch of reasonable size, you can improve the architectural appearance of the building greatly and at the same time increase its resale value by inclosing the porch. This has the effect of adding a room to the house. Indeed, the inclosed porch, which is now being made a feature in so many new houses, is utilized as a sitting room in many cases, at least during the milder seasons of the year. If radiators are provided, it can be used all year round.

There is nothing difficult about inclosing the average porch. It is a job any



Fig. 1. When you are inclosing an open porch, you are really adding an extra room to your house.

handy man can undertake with entire confidence of success. The main thing is to be familiar with the rudiments of the work and to plan the construction carefully in advance.

As open porches vary in design, the columns of some being square and others being round, some having rails and others being without them, two methods are illustrated. One (Figs. 2 and 3) suggests a simple yet workmanlike way of inclosing a porch with round columns; the other plan (Figs. 1, 4 and 5) is for a porch that has a railing and square columns. Various modifications and combination of the two types of construction can be made to suit individual needs.

It pays to make a sketch of what you propose to do and a tentative list of the necessary lumber, sash and doors. Then you can find out from your lumber dealer what he has in stock of the needed materials and what will have to be made to order.

In the case of (Continued on page 110)

How to Make Better Christmas Gifts

Wonderful New Way to Improve Your Craftmanship

LePage's New Books
Will Show You How

NOW WITH the coming of the holiday, gift-making season, when the man who has a home workshop especially enjoys his hobby of making useful, practical gifts that can be used and appreciated by everyone in his home—come these two NEW LePage's Craft Books to show you how to make better Christmas Gifts and how to improve your craftmanship. The titles of these two books are, "LePage's Practical Suggestions for the Home Workshop," and "LePage's Gesso-Craft Book."

Naturally when you tackle the making of an article like a breakfast nook, ship model or cedar chest, you want to come as near as possible to equaling the skill of the trained cabinet-maker. One of the things which he knows that you also must know is how to make strong joints—joints that combine strength with gracefulness and beauty. The only way to do this is with the use of glue, and this is exactly the information given you in these books. They tell you how to make strong joints with glue, and not only with glue, but with glue in its most convenient form—LePage's Liquid Glue.



Handiest Tool in Your Workshop

Perhaps you have never thought of the special advantages of using LePage's Liquid Glue. It is always ready for immediate use. No weighing, soaking or heating is required. Its quality is always the same. It "sets" slowly enough so that you have plenty of time to place the joints together exactly as they should go. Slow setting also allows LePage's to penetrate the wood, increasing the strength of the joint. LePage's Liquid Glue is equal in strength to any animal glue. Buy a can for your workshop. It is the easiest, quickest, handiest form of Glue. Insist on LePage's.

Recipe for making LePage's GESSO



Improve Your Craftmanship

These books also show you how to cover up small defects in your craftmanship. Now and then a tool will slip and an error is made. Or there are holes to be filled where nails or screws have been countersunk. Or the edges of a joint are not exactly even. A simple new way to repair these defects is with the use of LePage's Gesso instead of putty. LePage's Gesso will stick to any surface—wood, metal, glass, etc. It can be sandpapered, planed and painted or stained just like wood. We give you in the small panel at left a simple formula for making LePage's Gesso, but of course we tell you more about it in the books themselves, together with practical information on decorating your finished articles with Gesso.

Send 10 cents for these NEW LePage's Books

The practical and useful help of these two books is yours for only 10 cents. Just write your name and address on the coupon below, tear the coupon out and mail it to us today with 10 cents in coin or stamps, and we will at once send you a copy of these two LePage's Books, postage paid. Address, LePage's Craft League, Dept. 602, Gloucester, Mass. Tear out the coupon now so that you will not forget it.

**LE PAGE'S
GLUE**
Bottles, Tubes, Cans

LePage's Craft League,
Dept. 602 Gloucester Mass.
Gentlemen: Enclosed you will find 10 cents (coin or stamps) in payment for "LePage's Practical Suggestions for the Home Workshop" and "LePage's Gesso-Craft Book." Please send a copy of each to:

Name _____

Street _____

City _____

State _____

The Home Workshop

Inclosing an Open Porch

(Continued from page 110)

often is placed over the windows, especially when the porch is high (Fig. 1). This construction requires a transom bar, a detail of which is shown in the lower right-hand corner of Fig. 3. It is made up of No. 20, 21 and 22 combined with No. 2. The bar should be fitted together securely and neatly at the desired height.

Either casement, that is, hinged sash or single sash may be obtained to suit the openings at any sash and door mill or through your lumber dealer. The sash (No. 3, Fig. 3) nearest the columns may be hung on hinges and the others made stationary with screws. If dividing pieces have been provided between the columns, all the sash may be hung so as to open. If there is a headlight (No. 10), it is nailed fast. Screens are made and fitted to go outside. They may be kept in place by buttons or screws or with ordinary screen hangers.

The door opening will be defined by the space between the columns opposite the front door. A single door or a pair of doors may be used. Scribe pieces similar to No. 1 and No. 7 and fasten to the columns. Two jambs or posts are nailed in place between the porch floor and the soffit. Doorstops are nailed to these posts. If headlights are to be used, there should be one over the door, as over the windows, supported by a transom bar.

If it is wished (Continued on page 112)

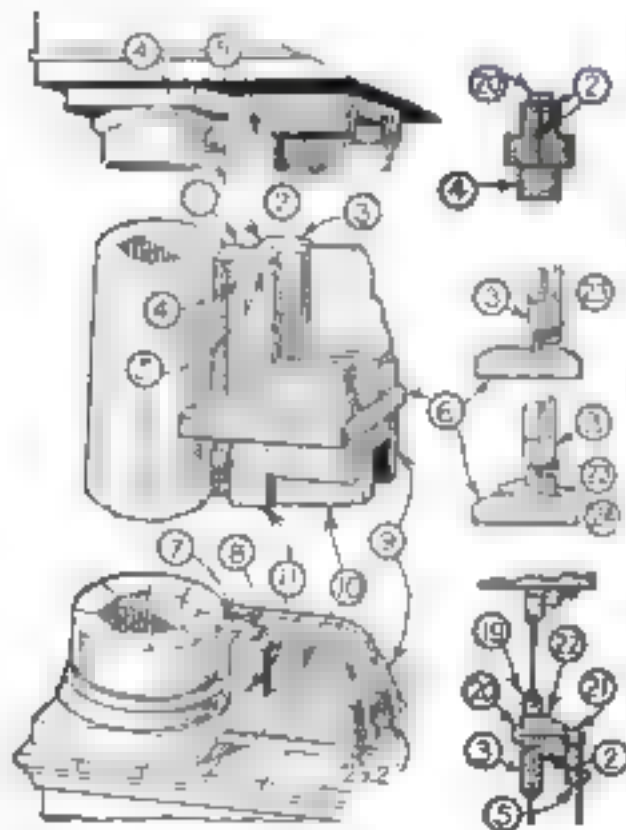


Fig. 3. A workmanlike and economical way of inclosing a porch that has round columns

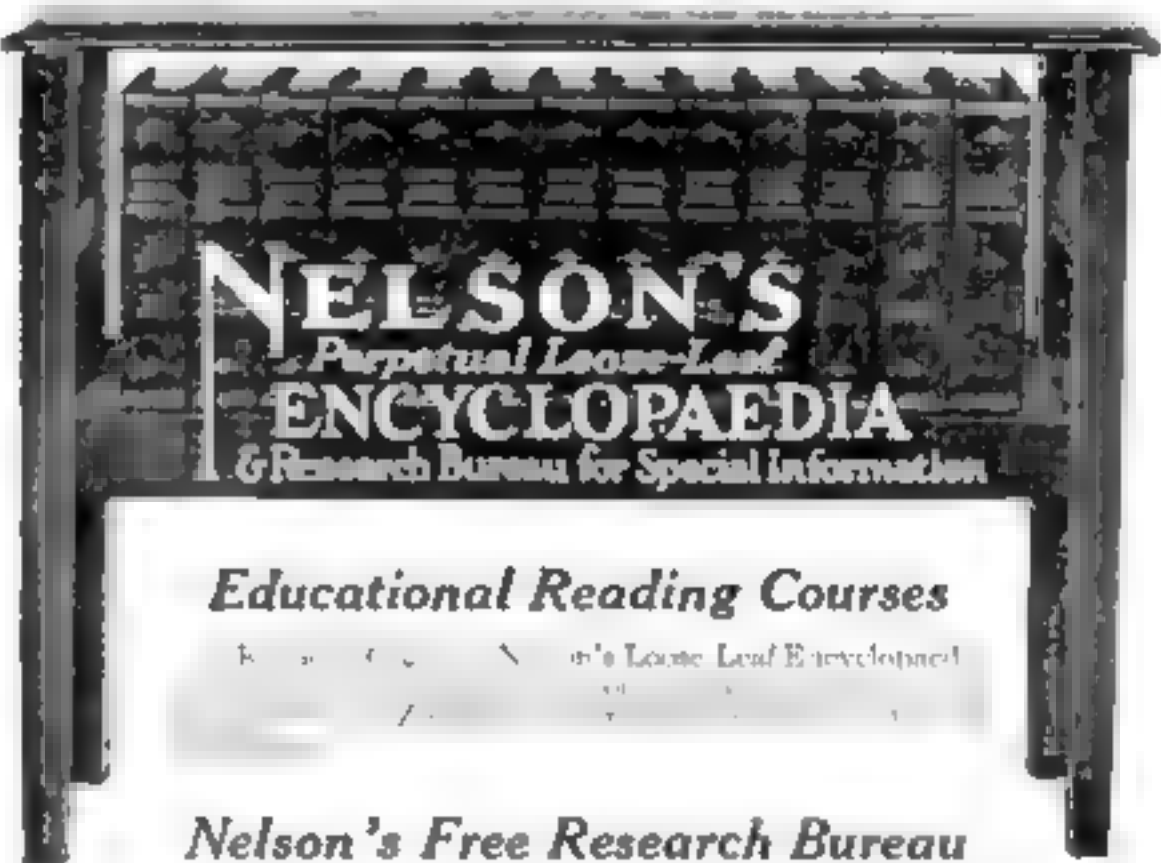
Fig. 1. Method for porch with round posts

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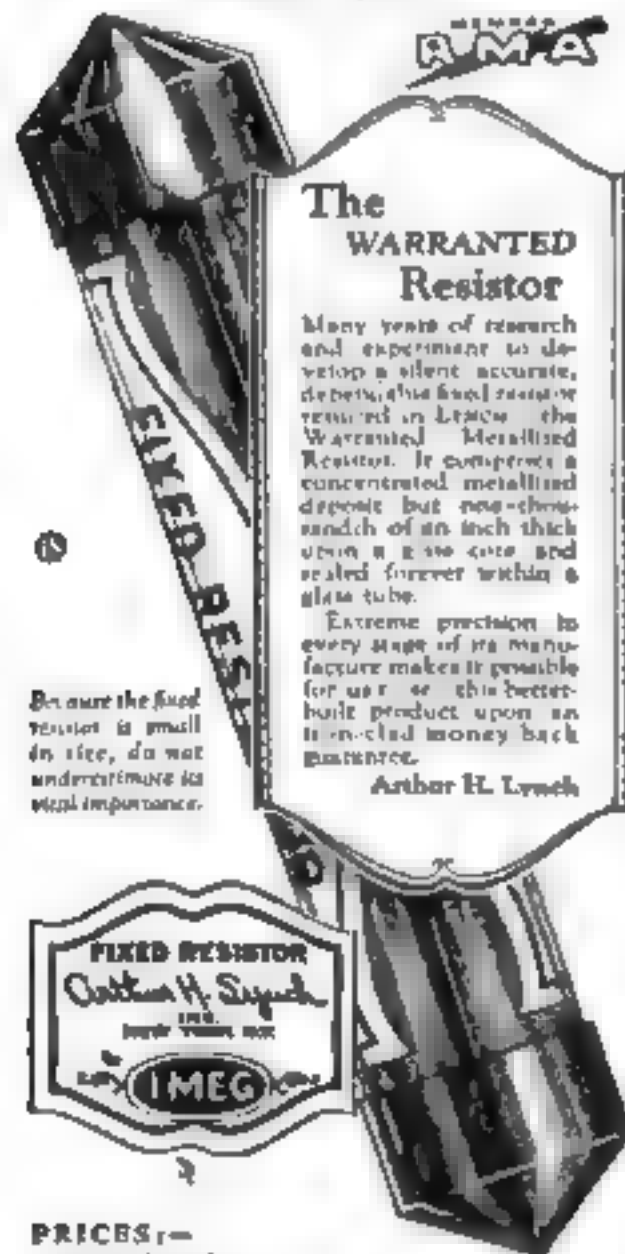
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Inclosing an Open Porch

(Continued from page 111)

to make the inside casement sash thoroughly weather tight at the bottom, they may be made as detailed in Fig. 3. The main sill, that is, the original porch rail or the piece added to it, is plowed (grooved) to allow a strip (No. 23) to be inserted, or a narrow $\frac{3}{4}$ -in. thick extra sill with such a groove (No. 24) may be added. Both methods are illustrated.

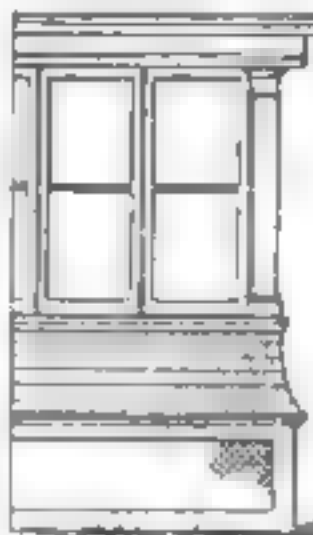


Fig. 4 Inclosed porch with square posts

To inclose a porch by the second method, which is an excellent one to follow where the old posts are not worth saving, begin by propping up the roof with a number of struts. Two by fours usually are strong enough if the roof is not of especially heavy construction. After removing all rails and posts, make a new

railing framework of rough two by fours. Leave the door opening as previously suggested, for jambs or posts will have to be placed for the door or doors, as well as a transom bar for the headlight if one is to be used.

Plumb down from each corner of the roof or beam above and make allowance for the thickness of the shingle lath and shingles before placing the rough framework. When the posts are finally put in position, they must line up correctly. If this allowance is not figured out accurately, the post may come either too far out or too far in at the top or else be out of plumb.

Wedge out the bottom shingle lath to suit the slight curve of the bottom shingle. Place a shingle in the lowest position and measure up 8 in. from the extreme butt in order to find where the next lath should be placed. The other laths are spaced to suit, usually from $4\frac{1}{2}$ to 5 in. center to center. Allow more at the top for the space taken up by the molding which goes under the rail.

The first row of shingles should be doubled, the joints of the outer shingles covering those in the under row. The shingle lath is shown at No. 17 (Fig. 5) and the shingles nailed to them at No. 15. The corner piece, No. 16, is $1\frac{1}{4}$ by 4 in.; No. 18 is the $\frac{1}{4}$ -in. tongue-and-groove ceiling and is nailed inside the bottom section to hide the rough framework. (Continued on page 113)

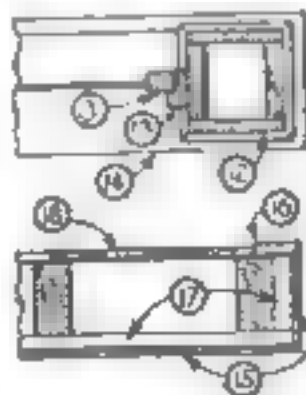


Fig. 5 Details of construction as in Fig. 4



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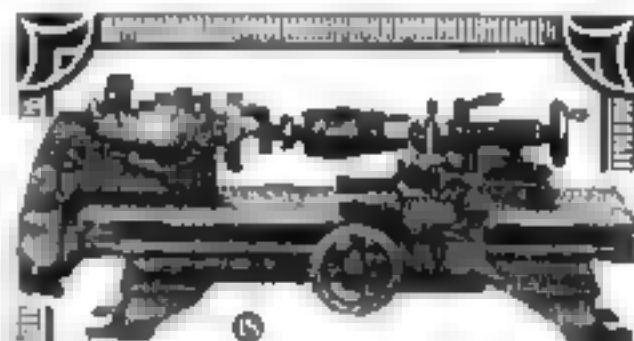
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Inclosing an Open Porch

(Continued from page 112)

The cap or rail (No. 14) must be wide enough to project over all the work so that a molding can be placed under it on each side. Boards 8 in. wide will be sufficient if the two by fours are laid with their 4-in. surface horizontal; 6 in. if the two by fours are laid with their 2-in. surfaces horizontal. The cap should be beveled slightly as shown at No. 6 in the first design.

If parts of the old posts cannot be utilized, new ones should be made to measure at least 6 in. square. Two pieces $1\frac{1}{2}$ by 4 in. and 2 pieces 1 by 6 in. can be nailed together to make a good post (No. 14). To give the post a finished appearance at the bottom, nail $\frac{1}{2}$ by 4-in. pieces at each side to form a base.

A rabbeted piece (No. 15) is carried up the post and across the head to receive the screens or sash. It should be $1\frac{1}{2}$ by $2\frac{1}{2}$ in. The crown or bed molding and the neck molding are butted against this piece. This allows the screens and sash to be placed without scribing or fitting them to the moldings, which is more or less difficult to do neatly.

The sash, as shown in this design, are fastened in with buttons. In the spring, some or all of the sash are replaced with screens.

It will be seen that this plan may be modified to take both sash and screens, as in the first design.

How to make lasting repairs to a leaky shingled roof will be the subject of the next article by Mr. Billing.

At Last a Place for Rubbers

(Continued from page 112)

dilute the saturated solution with one half water. Flood the stain on, wiping off the surplus, and when dry lightly sandpaper with 00 sandpaper. Then you will be ready to fill with a dark brown paste filler. After that is dry, apply three or four coats of white shellac, rubbing each coat lightly, and the last one rub down thoroughly with 00 steel wool. If you want more gloss, rub on a furniture or floor polishing wax."

Bill of Materials for Combination Umbrella Stand

The finished size of the pieces are as follows, all dimensions being in inches.

Parts	Pieces	T.	W.	L.
Legs	4	$1\frac{1}{2}$	$1\frac{1}{2}$	$22\frac{1}{2}$
Lower front and back rails	2	$1\frac{1}{2}$	$1\frac{1}{2}$	$17\frac{1}{2}$
Lower end rails	2	$1\frac{1}{2}$	$1\frac{1}{2}$	8
Compartment back	1	$\frac{3}{4}$	5	$17\frac{1}{2}$
Compartment ends...	2	$\frac{3}{4}$	5	8
Door	1	$\frac{3}{4}$	5	$17\frac{1}{2}$
Top rails	2	$\frac{3}{4}$	$1\frac{1}{2}$	$17\frac{1}{2}$
Side rails	2	$\frac{3}{4}$	$1\frac{1}{2}$	8
Top center bar	1	$\frac{3}{4}$	$\frac{3}{4}$	$18\frac{3}{4}$
Top crossbars	2	$\frac{3}{4}$	$\frac{3}{4}$	$18\frac{3}{4}$
Compartment top	1	$\frac{3}{4}$	$2\frac{3}{4}$	$18\frac{1}{4}$
Compartment bottom	1	$\frac{3}{4}$	$2\frac{3}{4}$	$18\frac{1}{4}$

Two 1 by 1 in. butt hinges; one $\frac{3}{4}$ -in. wooden drawer knob.

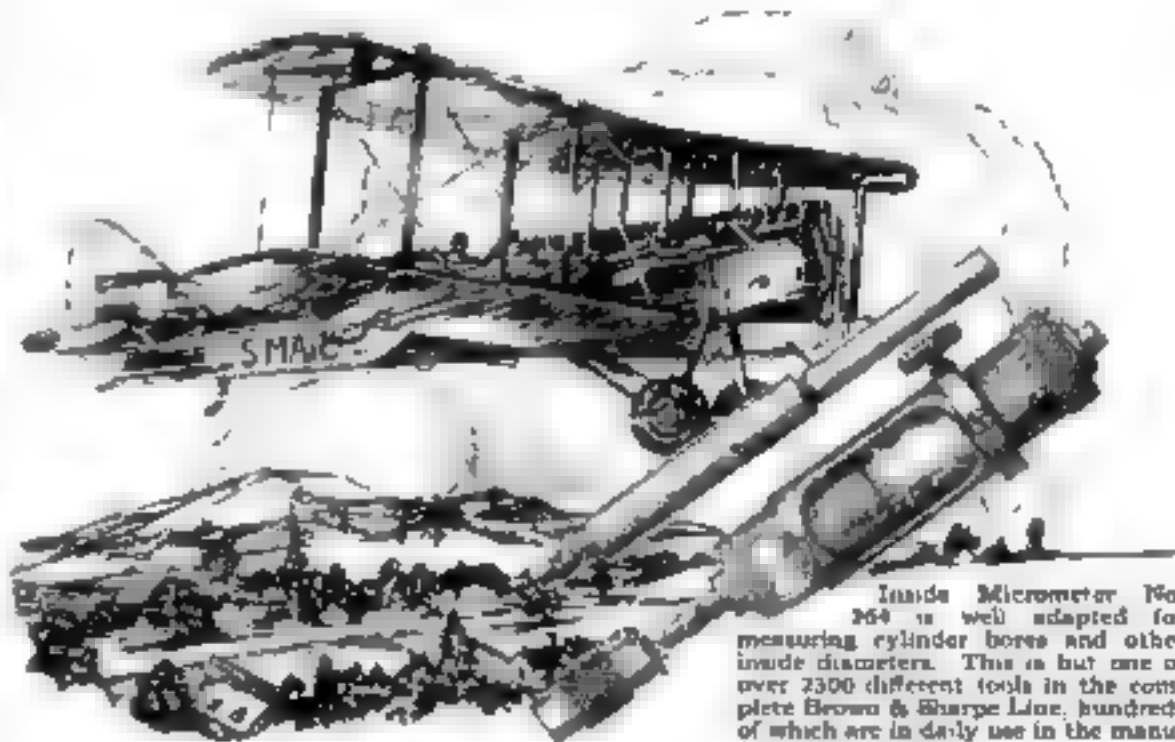
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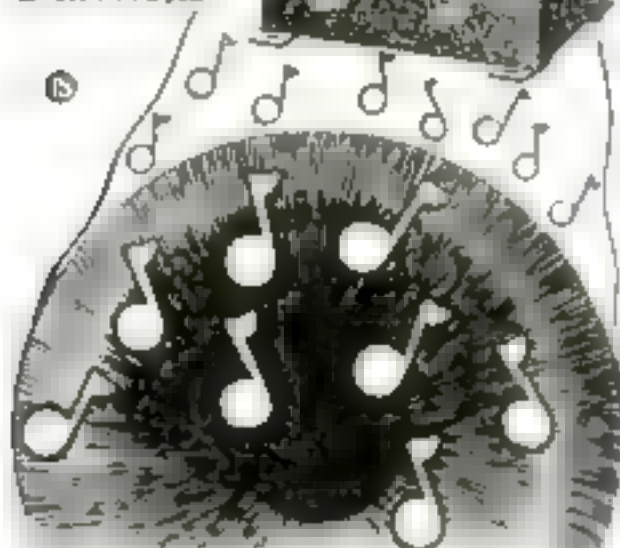
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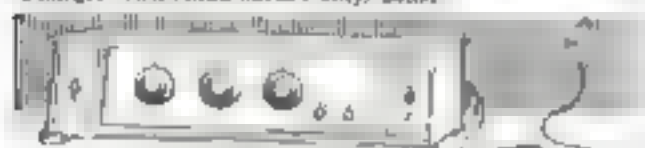
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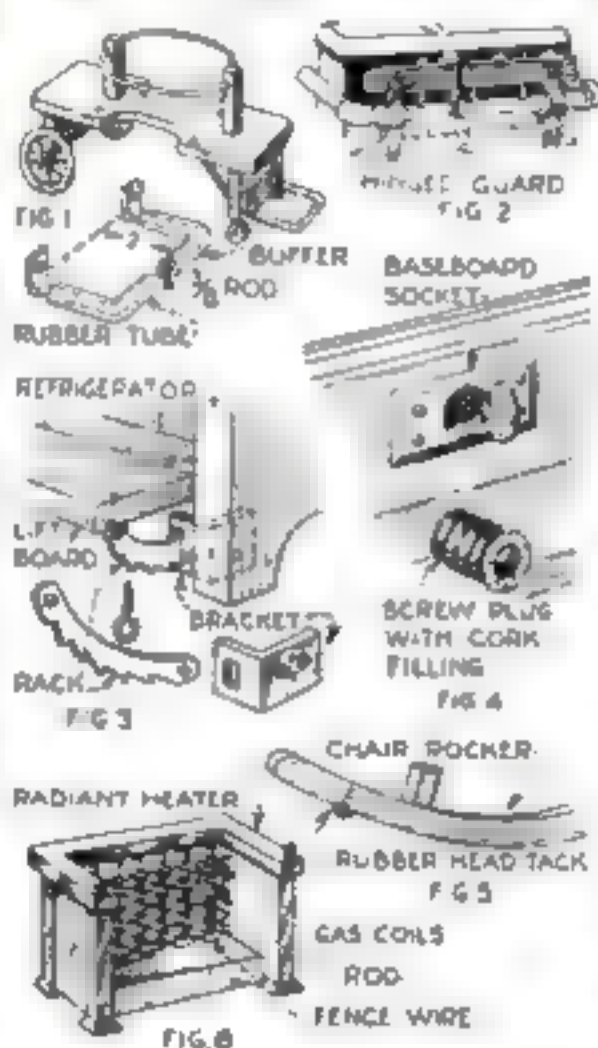
Safety First for Young Children

By F. J. WILHELM

THREE children in my city were killed within a year by falling out of windows because of the failure of the insect screens. For these accidents there was no excuse whatever. If the screens had been properly fastened and strongly made, the children would not have fallen.

Many painful and serious accidents to children could be prevented if the parents would use as much common sense in observing safety first practices in their homes as manufacturers are compelled to do in their factories.

Many baby creepers or walkers, especially of the cheaper kind, have a habit



Safety devices for baby walker, gas stove, ice box, baseboard socket, heater and rocker.

of turning over when the small front wheels strike a door threshold. When that happens the baby, not being able to escape, is thrown heavily on his face. Such mishaps can be avoided by fastening a bumper to the front of the car, as shown in Fig. 1.

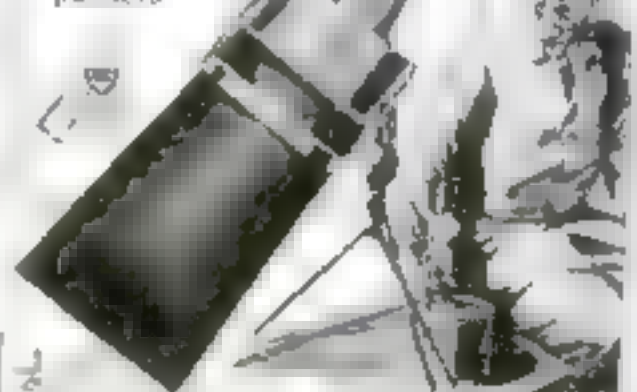
In playing house, children will sometimes turn on the gas jets of a gas range. This is most apt to happen when the children are left home alone. To prevent any possibility of an accident from this cause, a 1/2 by 2 in. wooden strip can be fastened to the feed pipe, as shown in Fig. 2. This guard can be raised and made fast by tightening either one or two thumbscrews. When the gas range is in use the guard hangs down.

The usual lift door in front of an ice box water pan is a natural trap to pinch children's fingers. A

(Continued on page 115)

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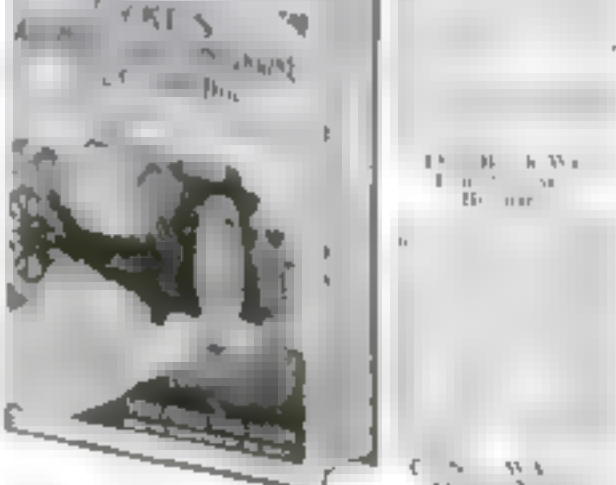
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The Home Workshop

Let's Hammer Out Some Copper Bowls

of jewelry making, and much of my knowledge of shaping the more precious metals was gained at the forge.

While I was still working in the blacksmith's shop, I spent two summers in a large boys' camp in New Hampshire as one of the masters, where I was to teach sketching and the designing required for the manual training course in woodworking. It seemed rather difficult for the boys and for me to get down to sketching in that healthy out-of-door life.

ONE of the boys found an old copper-bottomed wash boiler. Here was material for us, but we had no tools save a pair of tinner's snips borrowed from the woodworking shop.

Selecting a pleasant spot in the woods near a stream, we cut down a tree leaving the stump about three feet tall, and sawed the top square across. Then we built a camp fire, heated one end of an old iron bar red-hot, and burned a hollow in the top of the stump. Here was our forming block (Fig. 1, page 98). The campfire also was used for annealing any fire or torch will do if it will heat the copper to a dull red.

We had no forming hammer or mallet so, selecting a certain branch of a beech tree, we cut a part of this off to make a natural mallet. The larger part of the branch formed the head, a smaller branch, nearly at right angles to this, made a good handle. One end of the head was rounded over by whittling.

Those who wish to try decorative metal working and have had no previous experience can easily duplicate the success we had in making those copper bowls.

THE hollow in the forming block—about 1 1/4 in. in diameter and from 1/4 to 1/2 in. in depth—should be slightly larger than the rounded end of the mallet or forming hammer used for the bowing or doming up, which is sometimes called "bowl raising." Bowls of practically any size may be made over the same hollow, as the diameter of the hollow and the diameter of the bowl have nothing to do with each other.

If the water used in the annealing process contains about ten per cent of either nitric or sulphuric acid it is then called "pickle" and its action is such that all scale produced by the fire is removed so that the copper may be scrubbed bright and clean. When making pickle, always pour in the water first and then slowly add acid. However, the bowl will be just as soft if, after being heated a dull red-hot, it is quenched in plain water but the copper will remain dark. The fire really does the softening, the water cools it, the acid cleans it.

Number 20 soft rolled copper is an excellent weight for this purpose. The heavier weights or gages are rather stiff for the light tools described here.

To cut out a circular disk from a sheet of copper, scribe on (Continued on page 117)

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The Home Workshop

Let's Hammer Out Some Copper Bowls

(Continued from page 115)

the circle with dividers. Then cut out a square just inclosing the circle. Cut off each corner of this square almost up to the circle and finally turn the metal to the line.

When your copper disk has been cut out and annealed by heating it red-hot and quenching it in water or pickle, place it over the forming block. Start hammering with the curved end of the mallet so that the first blows come exactly in the center of the disk, over the hollow underneath. Then move the bowl slightly to one side of the center and hammer around the hollow depression you made first, thus working from the center gradually out toward the edge of the disk (Fig. 3). Hammer in concentric circles, round and round, until you work out to the very edge.

IN FIG. 4 are shown the various stages of shaping a shallow copper bowl. The bowl is annealed after the surface is hammered over each time.

A simple method of making a base is shown in Fig. 2. The bowl is turned upside down on the bench and a circle lightly scribed on the bottom in the center. The curved end of the mallet is then used to drive the copper down inside of the circle. The hammering is started in the center.

Bowl makers usually plan their work so that the bowl is well hammered after the last annealing to leave it stiff.

The wooden forming mallet should be about 1 1/4 in. in diameter with a head about 4 in. long. The forming block may be either a stump or a block of hard wood held in the vise.

The bowl may be colored if it is first "pickled" and scrubbed bright and clean with pumice powder. Coat it with turpentine or machine oil and bake it in an oven, taking care not to burn off the oil with too high a temperature. Iridescent colors are produced in this way, or, if the baking is continued long enough, a brown or gray will result.

GREEN may be produced by having the bowl perfectly bright and clean dipping it in the pickle, and setting it in the sunlight for several days. It should be remembered that the green so produced is very poisonous, particularly in a cut. The bowl's surface, therefore, should be covered at once with floor wax, clear lacquer, or varnish.

Another method of coloring copper is to use a piece of liver of sulphur (Pentachloride of Potassium) dissolved in hot water, a piece about the size of a hickory nut to a quart of water. The clean copper is dipped in this solution and then immediately rinsed in cold water. This same solution is used to oxidize silver.

In the next installment of his adventures in toolcraft, Mr. Thatcher will tell how he set up a most complete and practical home workshop in a 4 by 7 ft. room in a New York apartment.

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Interested in your Single? send catalog and my Dealer's name.
Interested in your dealer proposition? Is my territory open?

Name _____
Address _____

STOP THAT LEAK WITH SMOOTH-ON No. 1

You can apply Smooth-On with radiator full or empty, hot or cold, without removal from the car and without putting inside anything that clogs the circulation.



Merely roll the Smooth-On into a stiff putty, press it against and into the leak with your thumb or pack it into the defect with a knife blade or screwdriver, and scrape off the excess. The leak will stop instantly, and the repair is permanent. For a few cents and in a few minutes you will have avoided all the delays and expense of a professional repair job that couldn't be any better.

Bursting water jackets. Water jackets of automobile, stationary or marine gas engines which have developed long or short cracks or have even had pieces broken entirely out from freezing can be made thoroughly and lastingly serviceable by similar repair, or by applying Smooth-On under straps or a plate.

Smooth-On No. 1 can be used in a hundred ways in the household, and it often saves from \$50.00 to \$100.00 on the first job.

Keep a can of Smooth-On No. 1 with your tool kit and some day when caught with a repair job you will thank yourself for your forethought.

Smooth-On Mfg. Co.

Dept. 58

374 Communipaw Ave., Jersey City, N. J.



Write for
FREE BOOK



Do it with SMOOTH-ON

SMOOTH-ON MFG. CO. Dept. 58.

374 Communipaw Ave., Jersey City, N. J.
Please send the free Smooth-On Repair Book

Name _____

Address _____

**Return this coupon for
FREE copy of Booklet**

Get Smooth-On No. 1 in 7 oz., 1-lb., or 5-lb. tins at nearest hardware store or if necessary direct from us.

FREE

This booklet tells how to stop not only water leaks in radiators, bursted water jackets and at hose hose copper joints, but also how to stop gas leaks from the tank, gas line, pipes and exhaust system, and oil leaks at gaskets and at leaks in crank or gear case. It also tells how to make headlight glass tight, hub caps and bolt heads, grease cups stay tight, and shows in great detail many saving Smooth-On repairs. Send for it, you'll return the coupon.



Home Workshop Chemistry

Simple Formulas that
Will Save Time
and Money

ONE of the most useful chemicals in the home workshop is benzol, a comparatively inexpensive, light, mobile liquid, which can be obtained at the larger paint stores, drug stores or chemical supply houses. It is rather inflammable, burns with a smoky flame, and boils at 81 C or 177 F. It mixes readily with alcohol, ether and acetone, but not with water. It must be kept away from flames.

Benzol is used as a solvent for resins, fats, rubber, sulphur, phosphorus and wax. If stains of any of these substances are to be removed, moisten the stain with benzol on a rag and rub. If the stain is stubborn, soak the spot in a small dish of benzol until the material has softened and then remove the stain with a clean rag or a piece of blotting paper. This is one of the methods used by dry cleaners for the removal of such blemishes.

Benzol serves in an emergency for reconditioning old and unfit varnishes. Even the skins of a dried-out varnish may be reclaimed and made into a new varnish, which, when dry, will have characteristics similar to those of the original varnish.

Such scraps and dried skins of old varnish are dissolved by adding the benzol in sufficient quantities to make an easily flowing liquid. Allow the mixture to stand for a few hours. The resulting varnish will be more or less elastic and hard and will dry quite rapidly. It will have excellent waterproofing properties and may be used for toys and other work that does not warrant the use of an expensive varnish.

A varnish for metal is prepared by dissolving sufficient asphaltum in benzol to make a solution of creamy consistency. The addition of a teaspoonful of heated linseed oil to an ounce or one ounce of the oil to about one half pint of asphaltum varnish makes a more durable and flexible varnish, useful both on metals and on glass.

For your convenience, the following label has been prepared for pasting on the benzol container.

Benzol

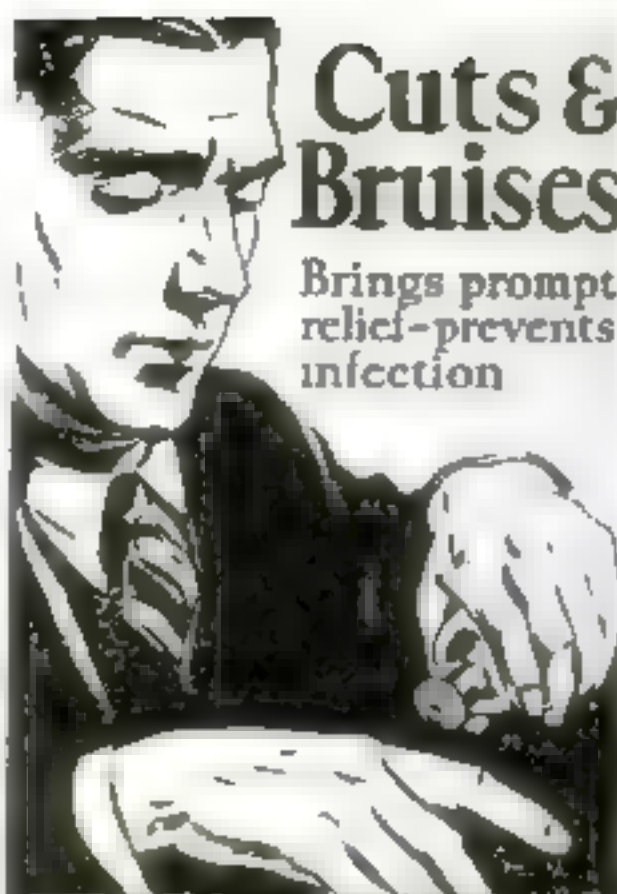
(Also known as Benzene not Benzol, C_6H_6)
Keep in tightly sealed bottles. Never expose to flames. It is quite volatile and burns readily.
Is a dry cleaner it removes stains left by fat and varnish.
It dissolves thickened varnish and varnish skins and converts them into varnishes that have waterproofing properties and are suitable for a common grade of work.
It dissolves asphaltum and forms a varnish for iron and steel.



Removing "dried-out" asphaltum in benzol

Cuts & Bruises

Brings prompt relief—prevents infection

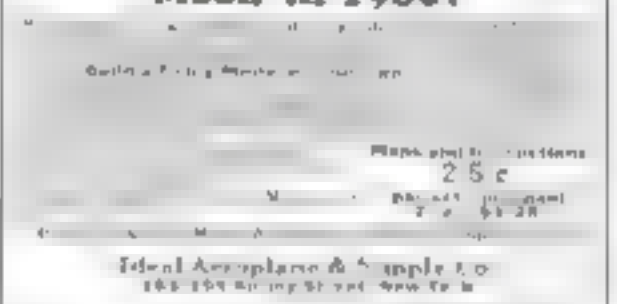


Absorbine Jr.
THE ANTISEPTIC LINIMENT

at all Druggists 1/25



Will we fly to the
Moon in 1936?



A 2c Stamp

—will start you on the road to success. See Money Making Opportunities on pages 136 to 165.

FREE—OUR 34-PAGE CATALOGUE FILLED WITH RADIO BARGAINS. WRITE TODAY!
RANDOLPH RADIO CORP.
208 N. GARDEN ST., CHICAGO, ILL.



SAY! LISTEN!

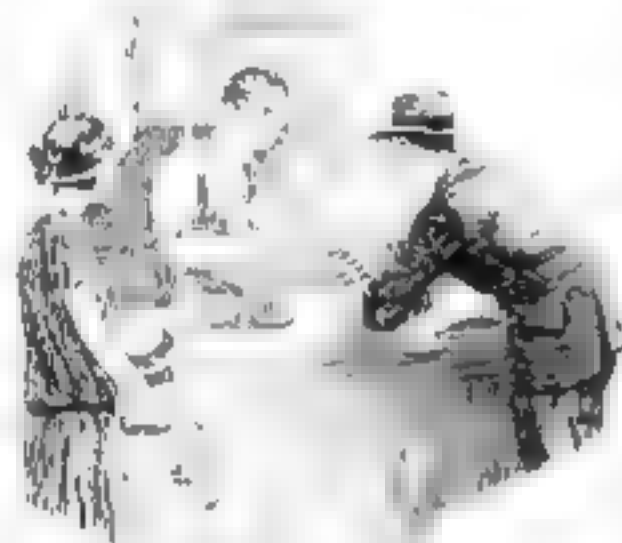
A NEW PAIR OF PANTS MATCHED TO YOUR COAT AND VEST. Just double the life of your suit. We can match almost any suit. 70,000 per cent. Sample is sent for your fit before making. All made to measure. Send piece of cloth or vest for matching.
ACME PANTS MATCHERS
Dept. A12, 30 W. Jackson, Chicago
Enclose return postage if vest is sent

The Shipshape Home

An Expert Answers Your Paint and Varnish Questions

WHEN you have a question on any subject relating to the use of paint and varnish in keeping your home shipshape, you usually ask your hardware or paint dealer for help. That has made it possible to find out from various dealers what are the ten paint and varnish problems most frequently encountered by amateur painters.

The hardware and paint store is, indeed, a barometer of what the people in any locality use in paints and varnishes. Ten hardware stores, five located in various downtown and residential sections of one of the large cities, and five in



Amateur painters ask their paint dealers many questions, of which the ten most common are answered in this article.

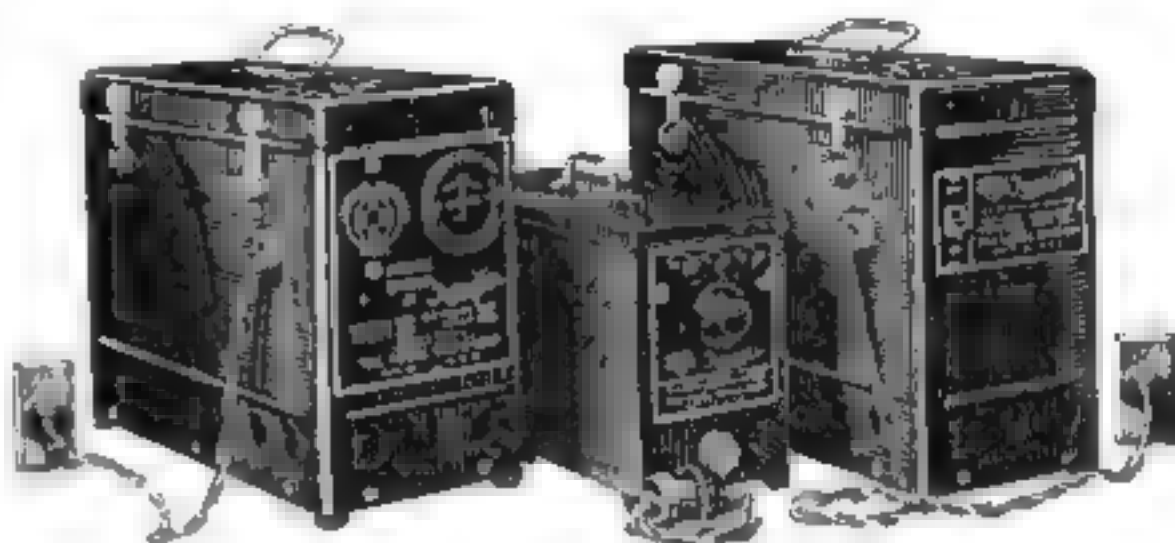
small cities and little villages—will fairly represent the paint and varnish requirements of the country as a whole. The questions most frequently asked these dealers will represent the problems of the majority of paint and varnish users.

Here are the questions, together with brief answers: (Two very common questions are excluded, as they obviously cannot be answered on these pages—"Which is best for outside painting, prepared paint or lead and oil?" and "Which brand is the best?")

1. How much paint will it take to paint my house?

This may be estimated by measuring the distance around all four sides and multiplying by the average height, which gives the square feet. Divide this by the covering capacity of the paint used, generally considered as about 300 sq. ft. (2 coats) to the gallon for prepared paint. Thus, however, (Continued on page 120)

A-B & C Light Socket Radio Power



for any set • new or old

Now all Radio Power is in your light socket. A. B. & C. Kodol Transifiers replace all batteries. Just plug in the wall socket and smooth A, B and C current flows to your receiver—gives new pep, new life to any set—larger range, greater volume. Transifiers create an altogether new standard of really fine reception.

Kodol A & B Transifiers

Are vastly different and superior to so called power units. Transifiers consume current only while you operate the set. Much lower maintenance cost. Less than one half cent per hour to operate both A and B Transifiers. You may purchase both A and B or either model separately from your radio dealer.

MODEL 10 "A" TRANSIFIER	MODEL 61 "B" TRANSIFIER	MODEL 10 "E" TRANSIFIER
Supplies constant 2.4 or 4 volts A power to sets using up to 18 tubes. Absolutely no hum, noise or interference.	Smooth, powerful, noiseless "B" current for sets up to 6 tubes. 22½ to 90 volts.	22½ to 150 volts "B" power, 4 to 18 volts "C" power. Constant uniform current to supply any size set. Will operate power tubes.
Price without bulb . . . \$42.50	Price without bulb . . . \$28.50	Price without bulb . . . \$42.50

["Behind the Scenes in a Broadcasting Station", an interesting 24 page booklet together with literature describing Kodol A and B Transifiers, will be mailed free on request.]

DEALERS: Write for particulars on Kodol Radio power devices.

THE KODEL RADIO CORPORATION, 500 EAST PEARL ST. CINCINNATI, O., U. S. A.
Owners and Operators of Broadcasting Station WERC

Battery Chargers
Power Units

KODEL Radio Receivers
Loud Speakers

POWER SPECIALISTS SINCE 1912

CORONA

THE PERSONAL WRITING MACHINES



IN AN HOUR, WITH CORONA, you can clean up the rag end of a day—and every word you write is clear, legible, neat.

If you haven't a Corona in your home, ask the local Corona dealer to see our standard keyboard model; or just clip the coupon below.

CORONA has all these modern features:

The keyboard has four rows of keys—the same as office typewriters. You don't have to shift for figures.

Instead of a one-yard ribbon, Corona's automatically reversing two-color ribbon is twelve yards long.

The large self-spacing carriage return lever is right up where you want it for quick action. Corona is the only portable with a real variable line spacer. There is also a convenient stenciling device.

Corona has a shift key on each side. Back spacer and margin release are conveniently located on the keyboard.

You can see what you are writing without moving your head an inch. The visibility is perfect—and at right angles to vision.

The type bar action operates on exactly the same principle as that employed on all the best full-size machines—the type comes up to strike the paper.

The full-width carriage takes a No. 10 envelope—just like any office machine.

Over 700,000 Coronas, more than all other makes of portables combined, prove Corona's durability.

MODELS AND PRICES

The price of this standard keyboard Corona is \$60 with case. Other models at \$50. Special keyboards available for all foreign languages and technical writing. Dealers will accept used typewriters as part payment.

Mail this today

L. C. Smith & Corona Typewriters Inc.
718 E. Washington St., Syracuse, N. Y.

Without obligation to me, please send me latest information about Corona.

Name.....

Address.....

WE SHAPED HOME

Your Paint Questions

(Continued from page 110)

is only approximate, as some makes of paint cover more surface than others, and conditions of the surface differ.

Where lead and oil are used, 100 lbs. white lead, $4\frac{1}{2}$ gals. linseed oil, 1 qt. turpentine and 1 qt. drier will make about 8 gals. of mixture capable of covering 300 sq. ft. (2 coats) to the gallon (when the priming coat is properly thinned). This also is only approximate.

Allowances should be made for gables, bays and other projections. For the trim, cornices, and so forth, about one-sixth as much paint is required as is needed for the body.

2. How much material will it take to paint, varnish, stain or enamel a room?

Ascertain the square feet of surface. Divide this by the covering capacity of the material used. In estimating the area of ceilings or floors, simply multiply the length by the width. For walls, multiply the distance around the room by the height, and subtract 13 sq. ft. for each average sized window and 21 sq. ft. for each average door. For standing woodwork, the doors will average 21 sq. ft. each, window casing and sash about 10 sq. ft., and baseboard about 2 sq. ft. per running yard, but all may readily be measured exactly.

Flat wall paint, as a rule, covers about 300 sq. ft. (2 coats) to the gallon on hard smooth plaster, about 250 sq. ft. on rough or very porous plaster, and about 350 sq. ft. over previously painted walls.

Stain usually will do from 500 to 600 sq. ft. (1 coat) to the gallon. Enamel and enamel undercoater will ordinarily do about 350 to 400 sq. ft. (1 coat) to the gallon. These figures are based on average surfaces and average conditions.

3. How should I enamel the bath room woodwork white?

If it is to be done over a previously enameled finish, simply sandpaper the surface to cut the gloss and apply one coat of enamel. If necessary, apply two coats, sandpapering between coats. If over new woodwork or previously varnished woodwork, build up a foundation with flat undercoater. The following produces a good finish: First coat, undercoater; second coat, half undercoater and half enamel; third coat, straight enamel. If found necessary, apply another coat of full enamel.

4. What should I use to paint the kitchen and bath room walls?

Kitchen walls are subjected to such greasy fumes and deposits from cooking that regular flat wall paint becomes soiled quickly and is difficult to clean without streaking. Semi-gloss wall paints are to be preferred. Where these are not available ready prepared, a very pleasing semi-gloss finish can be obtained by mixing equal parts of flat wall paint and varnish. Many also like a full enamel finish, the porcelain-like surface of which may be most easily cleaned. *(Continued on page 121)*

Ingersoll

PRICES REDUCED



The New YANKEE
Now \$1.50

Reduction Applies to Entire Line

Douglas MacLean says, "You can't beat a Lyon & Healy saxophone for tone or for ease of playing!"



"I've heard 'em all and I can tell the difference with one ear. The Lyon & Healy saxophone!" Doug MacLean says. Douglas MacLean, Famous Player, is an earnest musician, but he knows just what when he hears it. He has found, too, the secret of popularity—knowing how to do things. Take those you will find our simplified instruction easy to follow, easy to play clear, loud and mellow. The choice of professional musicians, also, because of its perfect pitch, accurate adjustment, beautiful finish.

However, for yourself the advantage of our special offer to you while you play—play with the new Lyon & Healy saxophone. Write to us today for our special offer to you while you play—play with the new Lyon & Healy saxophone. Let us help you easily, quickly, really, but at once.

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10 E. Jackson Blvd. Chicago, Ill.
Everything Known in Music

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LYON & HEALY, Inc. Factory Sales to East Jackson Blvd. Chicago, Ill. Please send me your remarkable new Saxophone Book and full details of your special "Easy to play" offer.

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City..... State.....

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Pocket \$10 A Week With Amazing New Cap

New adjustable feature makes Fits-U cap fit any head in minutes. A perfect fit means 36 distinct 1/2-inch color combinations. Fits head shaped with 20 turns up. Amazingly low price. Every man and young man wants one of these. Write immediately for it, also, or full details about the FREE cap by air mail.

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Hundreds of other make \$10 a week wearing this outfit. The Fits-U Adjustable Cap. We furnish complete selling outfit FREE. Write immediately for it, also, or full details about the FREE cap by air mail.

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He puts the PEP in the party

He's indispensable! this popular fellow who puts the pep in the party with his sweet singing

BUESCHER

True Tone Saxophone

You, too, have a natural desire to produce music. "Oh! If I could only play some instrument" you have said to yourself. Then you have thought of long hours of practicing scales, with possible failure in the end, and you have been afraid to try. Listen!

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If you can whistle a tune, if you can beat time, you can learn to play the Buescher Saxophone, Easily! You can teach yourself, at home, in a few evenings. Three simple lessons given on request with each new Saxophone start you. You learn scales in an hour and start playing tunes in a week. Your progress will astonish and delight you and surprise your friends.

Try Before Buying. Easy Terms

Take home with you any Buescher instrument, Trombone, Cornet, Trumpet, Saxophone for six days' trial. Test it. See what you can do with it. If you like it, pay a little each month. Play as you pay. Satisfaction guaranteed. Send for beautiful free catalog of any instrument and details of trial and payment plans. No obligation. Do this today.

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Gives complete history and tells why the Buescher is so easy to learn to play. In it you will find the first lesson chart. You must have this free book.

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Gentlemen: Without obligating me in any way please send me your free literature. I am interested in the instrument checked below.
☐ Saxophone ☐ Cornet ☐ Trumpet ☐ Trombone ☐ Tuba
Mention any other: _____
Name: _____
Address: _____

Shipshape Home

Your Paint Questions

(Continued from page 110)

when they can be obtained. Flat wall paint can be used on radiators and heated metal surfaces with good results.

8. What kind of paint should I use on stucco and concrete buildings?

Specially prepared concrete building paints are made for this. One of the principal requirements is an exceptionally large amount of liquid vehicle (oil and turpentine) on account of the extremely porous nature of these surfaces. First, the surface must be entirely free from dirt and particles of sand. Second, any salts or efflorescence should be scraped off. Third, the surface should be washed with a solution of zinc sulphate and water, mixed in the proportion of 3 lbs. zinc sulphate to 1 gal. water. This should be allowed to stand three or four days after application to give the water in the solution a chance to dry out, as the surface must be thoroughly dry when the paint is applied.

9. What should I use on concrete floors?

Concrete floor paint is made ready for use. The first coat should carry a large amount of turpentine to satisfy the absorption demands or be mixed with a varnish mixing size to seal the porous surface.

10. How is a dull finish produced?

The finest dull finishes are produced by rubbing with pumice stone and oil. This is a slow and, therefore, costly process, and the majority of dull finish effects today are produced with flat varnishes. These are applied the same way as any other varnish. Unlike most varnishes, however, the can should be shaken vigorously, or the material stirred just before using, as the flattening ingredient has a tendency to settle.

The most beautiful effects are produced when the flat varnish is applied over a full lustrous coat of gloss varnish. The finish may be varied from dead flat to semi-dull by the addition of a small amount of gloss varnish to the flat varnish. —HENTON ELLIOT.

Next month—the wonders you can work with colored enamels.

Rubber Feet for Scales

WOODEN BLOCKS

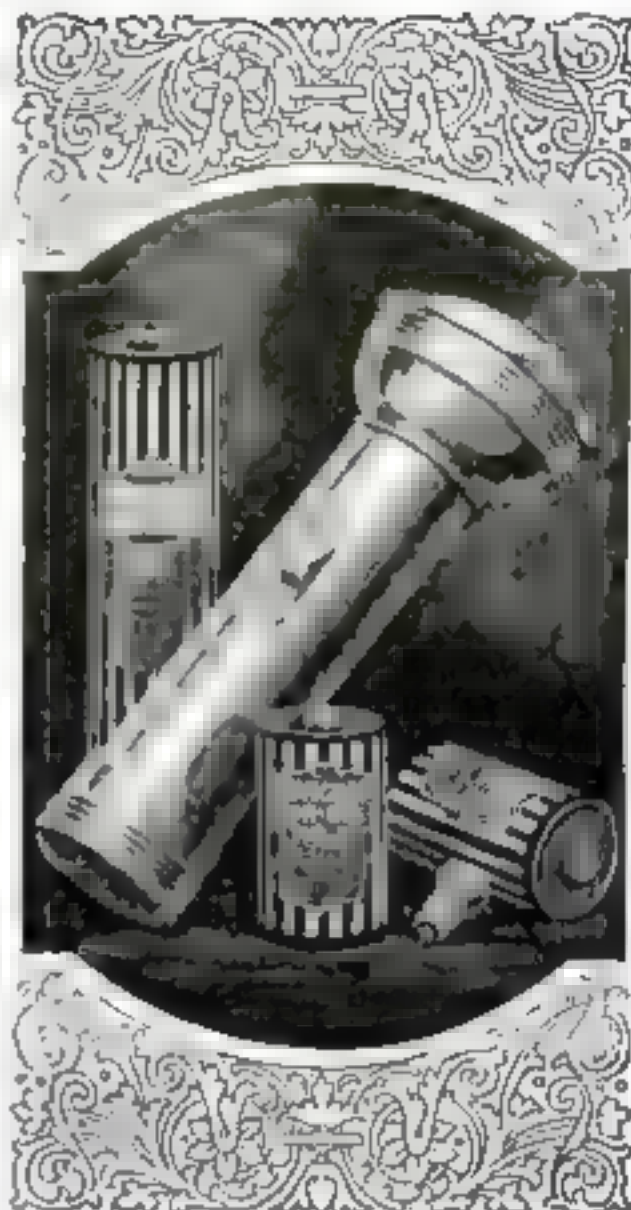
SCALES



FEET OF BICYCLE
TIRE TREADS

shown.—H. A. GUSTAFSON.

Our family scale caused numerous scratches on a few tables upon which it was used before I prevented further damage by fastening four pieces of bicycle tire tread to two wooden blocks and screwing the blocks beneath the bottom as shown.—H. A. GUSTAFSON.



Better Flashlights

BURGESS flashlights and batteries provide a most economical service for night-time emergencies, when to be without safe, controlled light may mean serious accidents, delay and certainly much inconvenience.

You will find many sizes and designs in the Burgess selection. Handsome metal or fibre cases, short-circuit proof and dependable in all weather.

Burgess Flashlight Batteries fit all makes of flashlight cases and their service reflects the same craftsmanship and skill which has earned world-wide recognition for the Burgess Radio Batteries.

BURGESS BATTERY COMPANY
GENERAL SALES OFFICE: CHICAGO

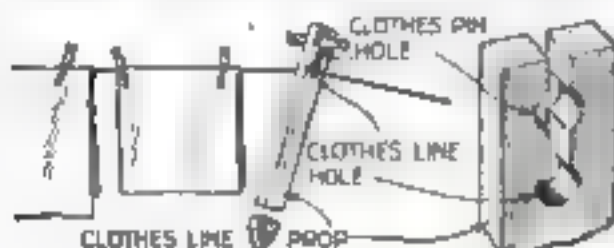
Canadian Factories and Offices:
Nagato Falls and Winnipeg

BURGESS
FLASHLIGHTS &
BATTERIES

The Shipshape Home

Prop for a Clothesline

CLOTHESLINE props of the common homemade variety, with a V-shaped notch in the top, have a habit of slipping and allowing the wash to sag. To avoid this, it is merely necessary to bore two holes at the top of the prop and



A clothespin is pressed into the upper hole to prevent the clothesline from slipping out.

make two saw cuts through them as shown. When the prop engages the line, a clothespin is slipped through the upper hole to prevent the line from slipping out.—MARGUERITE B. SPREEN.

Rack for Moldings

THE HOME worker who does much woodwork has difficulty in keeping

his cellar shipshape. An aid in doing this for the man who is always undertaking odd jobs around the house is the molding rack constructed as shown. It requires only two boards for uprights and odds and ends of scrap lumber. On it may be stored moldings and miscellaneous pieces of small dimensions. Everything is kept visible, accessible and orderly by this very simple and easily made arrangement.—R. M. S.



For holding your usable odds and ends of wood.

Repairing Heating Wires

BROKEN heating wires in electric toasters, stoves and similar appliances often may be repaired simply by gripping the ends between two washers, which are held together by a small bolt. Bolt and washers small enough for this purpose can be found in toy structural steel sets which, by the way, often will furnish repair parts for work about the house, when they are needed in a hurry.—W. J. E.



The broken ends are thus bolted together.

To IMPROVE badly worn cork linoleum, scrub it with warm water and a mild scouring powder and, before the surface dries, rub thoroughly with medium steel wool. Then apply two coats of floor varnish or wax.

Remington Portable for maximum speed and portability



THE Remington Portable is the most famous typewriter in the world. It is the smallest and lightest portable typewriter with four-row standard keyboard. It has the greatest capacity for work. It is incomparable for strength and durability. It is the recognized leader—in sales and popularity.

Take the Remington Portable with you wherever you go. It is the smallest and lightest portable typewriter with four-row standard keyboard. It has the greatest capacity for work. It is incomparable for strength and durability. It is the recognized leader—in sales and popularity.

Send for our booklet, "For You—For Everybody," to Department 67.

Remington Portable can be purchased on terms as low as \$5 monthly.



Wright's 8's pounds net

Carrying case only 4 inches high

Remington Typewriter Company

374 Broadway, New York

Branches and Dealers Everywhere

Remington Typewriter Company of Canada, Limited
68 King Street, West, Toronto

Remington TYPEWRITERS

A Machine for Every Purpose

Remington-made Faron Ribbons and Red Seal Carbon Papers always make good impressions



Look Sent on Approval

Adjusted to the Second; Adjusted to Temperature; Adjusted to Isochronism; Adjusted to Precision 21 Ruby and Sapphire Jewels 25-year Gold Bristle Case Your choice of Metal (Including Monogram) E. R. Hall. New Ideas in Thin Cases.

The 21 Jewel Santa Fe Special

We will send this famous watch, express prepaid, for you to examine, to inspect, to admire, to approve without one penny advance payment. Examine the watch and be convinced it's the best watch buy you ever saw. Just a small payment down, the balance in easy MONTHLY payments. You use the watch while paying for it.

Save 1-3 to 1-2 of Your Money

By purchasing this Famous Santa Fe Special Watch. Not only are you saving money from the present day prices of watches, but you can still secure the Santa Fe Special Watch at the same low prices and terms that have made our watches famous.

Ladies' Wrist Watches

Artistic, dependable ladies' wrist watches—perfect timepieces, beautiful hand-engraved cases in white or green gold. Read for New Watch Book and see the new shapes and designs. Sent on approval and sold on payments.

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Clip the coupon, fill out and receive the FREE WATCH BOOK just off the press. All the newest watch case designs in white or green gold, fancy shapes and thin models are shown. Read our easy payment offer. Wear the watch 30 days FREE. Watch sent for your examination and approval without a penny down. Nothing to risk. See the watch before you buy.

Write for New Book Today and Select Your Watch. Mail Coupon.

Santa Fe Watch Company

A-40 Thomas Building,
Topeka, Kansas

(Home of the Great Santa Fe Railway)

FREE A Limited Offer!

With every Santa Fe Memorial a beautiful gold chain or strand of exquisite pearls. Write while offer lasts.

FREE BOOK COUPON

Santa Fe Watch Company,
A-40 Thomas Building, Topeka,
Kansas.

Enclosed prepaid and without obligation your New Watch Book Free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

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State _____

See New Financial Department
on Page 4 Front Section.

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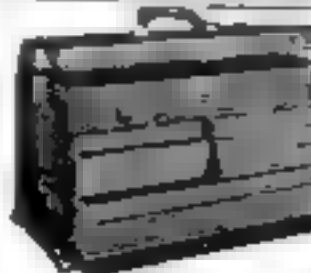


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or 3 months

Write for full particulars in booklet or
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FOR PARTICULAR MEN
Toolmakers and
Mechanics will find the
right Case in our

FREE CATALOG
Send for it TO-DAY
E. GERSTNER & SONS
524 Columbia St. Dayton, O.

Better Shop Methods

Old
Bill
says—



Old Bill, machine
shop foreman

A COLD chisel, hammer and file are tools enough to test a man's mechanical ability. Observe how he grinds the chisel, holds the file, and swings the hammer.

The ability to adapt himself quickly to varied conditions and circumstances is another indication of a first-class workman.

Good mechanics, too, never grumble about the shop or the tools with which they have to work.

They're sure they're right before going ahead, and they know what to do without being told.

Show an interest in the young apprentice and help him whenever you can.

It is inevitable that errors will creep into a complicated machine drawing, so don't be too harsh in criticizing the draftsman—he's human like yourself.

Don't try to grind your personal "axe" in this shop, or in any other.

Gages should be kept clean and handled carefully.

It is becoming more and more the custom to establish "standard time" for work to be performed in the machine shop; standard time is merely the shortest possible time in which a job can be done.

Quick Acting Jig for Drilling Uses a Wedge as a Clamp

FOR drilling cross holes in round stock, the jig illustrated, which employs a wedge for clamping, allows rapid work. The blank is inserted and the wedge tightened by a hammer blow. Striking the other end of the wedge releases the piece.



The drilling jig

What do You have to say

when you are with interesting people?

Can you hold up your end in a general conversation—or are you tongue-tied when with people?

AFTER the weather has been discussed and exhausted it is only the well informed man—the good talker—who can hold the attention and interest of his friends.

Everybody envies a good talker. You know from experience the big advantage the man or woman has who is an easy, fluent talker. In every-day life men and women who have this personal advantage are popular—sought after. And in their trade, business or profession they are the ones that get to the top.

The valuable ability of being able to converse smoothly, naturally and with full confidence is based on having at your command a fund of knowledge that will be of interest to those you are talking to.



What Worth-While People Are Talking About

Today the most entertaining, the most fascinating subjects are those that deal with applied science—radio... aeronautics the automobile; new discoveries in health... evolution... electricity.

These are the subjects that intelligent people are thinking and talking about. These are the things the worth-while men and women of your town or city are discussing.

To make it possible for you and the other thousands of men and women who feel the urge to keep up with the important things scientists have definitely established and the new discoveries that they are making we offer you THE POCKET GUIDE TO SCIENCE and 14 issues of POPULAR SCIENCE MONTHLY—all for less than 12 issues of POPULAR SCIENCE MONTHLY would cost you on the newsstand.

THE POCKET GUIDE TO SCIENCE is written in simple question-and-answer form that educators have found to be the most effective way for telling the known facts on a specific subject. In this one brilliant book of 284 pages

have been condensed all that you probably will ever want to know about science.

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POPULAR SCIENCE MONTHLY "carries on" from where THE POCKET GUIDE TO SCIENCE leaves off. THE POCKET GUIDE gives you all that the scientists have discovered up to right now—POPULAR SCIENCE MONTHLY will give you all the important, interesting and new discoveries of science for the next 14 months.

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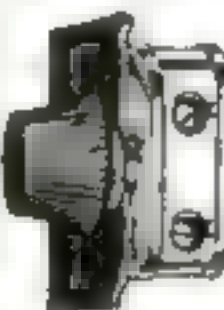
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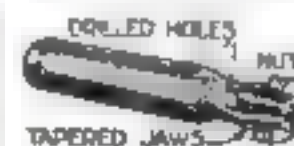
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Small Spring Chuck for Lathe or Drill Press

SMALL shops can use the simple type of chuck illustrated to advantage. The shank can be made straight as shown and held in a larger chuck. Or it could be



Simple, cheaply made type of draw-in chuck

tapered for use in a drill press or on a lathe. It is made of machine steel, case-hardened. The nut is a semifinished nut retapped with pipe thread. The

hole is made to fit the drill to be used, and the neck turned to increase the springiness of the jaws. The larger hole is drilled from the rear, and two hacksaw cuts are made to form jaws.

Semicircular Sharpener for Pointing Drawing Pencils

THIS simple pencil pointer for draftsmen consists of a semicircular wooden block about 2 in. in diameter. The curved surface is covered with a piece of emery cloth of any fineness desired. It is better to glue the

EVERY CLOTH
GLUED ON



A pencil pointing block for the busy draftsman

cloth on rather than use tacks. This form of sharpener seems to produce a better point than flat surface blocks.

Making Glue Stick

(Continued from page 117)

A bad odor from glue is a sure sign that it is rotting and losing its strength.

"After the first month on the job, Williams was told by the boss that he could run things to suit himself and order anything he wanted.

"All right," said Williams, "I'll take you at your word; put me down for a new set of aluminum glue kettles. This outfit you have here is all worn out anyway and it's not easy to get the best results yet with it. Aluminum is greasy by nature and glue does not stick to it as it does to iron or copper. It is also easier to clean. I want to make a rule to keep everything clean about this place. A little later on I may want other things, but just now the main idea is to be sure that every bit of glue we buy is of a uniform quality and that we always handle it properly."

DRAFTSMEN will find that many common calculations can be simplified if they will note down and use the numerical values represented by the sides of their 30-60 deg. triangle. If the hypotenuse is regarded as 1, the longer leg is .86603 and the shorter leg .5; if the longer leg is regarded as 1, the hypotenuse is 1.1547 and the shorter leg .57735; if the shorter leg is 1, the hypotenuse is 2 and the longer leg 1.73206.

Better Shop Methods

Double-Handled Tool for Scraping Bushings

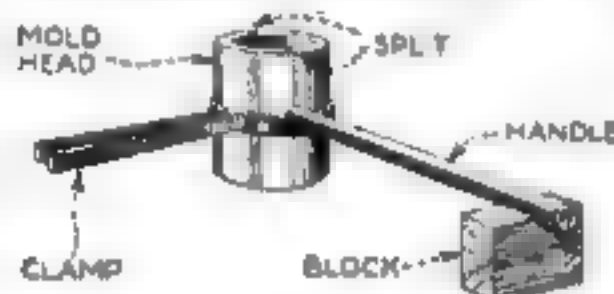


SCRAPING bushings with a single-end scraper is such a tedious job that one machinist made the double-handled tool shown. It has a tool steel blade that can be changed quickly for a sharp one. A small clamp holds the blade firmly in place.—W. L. M.

Casting a Soft Hammer

FOR assembling machinery and tools, the out-time soft hammer seems almost a necessity. In order to have a supply on hand, and at a low cost, we made up several sizes of molds for casting them ourselves.

The handles are short lengths of $\frac{1}{4}$, $\frac{3}{8}$, or $\frac{1}{2}$ in. pipe with the end split and bent

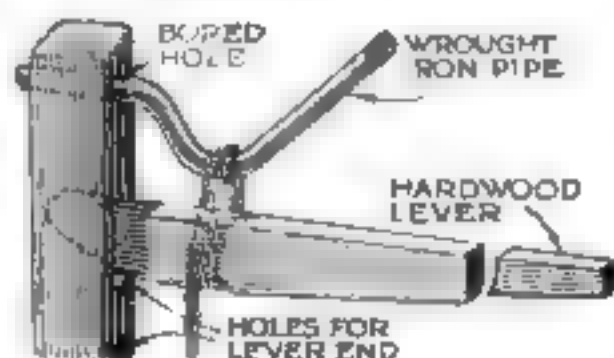


The handle, which is a piece of pipe, is inserted in the mold before the lead is poured

out to stay securely in the soft metal. The molds for the heads are pieces of pipe, 1, 1 $\frac{1}{4}$ or 2 in., depending on the weight desired, these are split and provided with a hole for the insertion of the handle. For each mold a clamp is made of light bar iron.

Most of the hammers are cast of commercial lead, which is the softest and also the cheapest. For harder hammers, babbit metal may be used.—W. C. C.

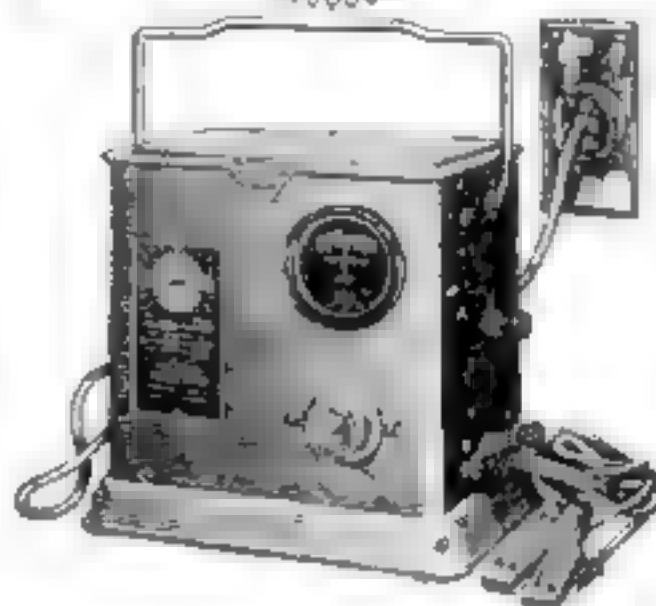
How to Bend Small Pipes without Special Tools



JUST because he was away from the shop and had few tools did not prevent one mechanic from bending some small pipe accurately and easily. He bored holes in a convenient post to receive the pipe and the end of a wooden lever, as shown. A short length of chain completed the equipment.—G. A. LUTER.

The New Triple Duty GOLD SEAL HOMCHARGER

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old radio tubes back to life without removing them from the set.

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Better Shop Methods

Movable Lamp Stand for Lighting Lathe Work

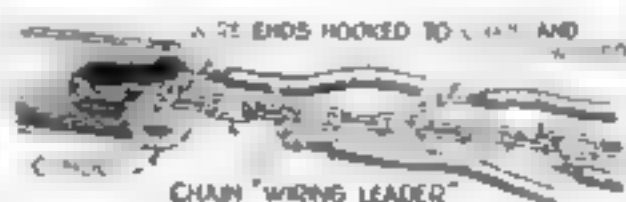


The light can be adjusted to suit turning or boring jobs

CONSTRUCTED of Corrug pipe and parts, the lamp stand illustrated will be a useful addition to the "lathe tools." The base should be heavy to prevent overturning an old piston will make a good one. The flexible metal conduit and the shade are about all that will have to be bought. The stand can be placed behind the lathe or moved away when not in use. A blue lamp of about fifty or sixty watts seems best.—H. L. W.

Chain Aids in Pulling Wires Through Small Conduits

ONE electrician found that a chain was better than the regular fishing tape for pulling a number of electric wires into a small conduit. The wires are hooked to different links of the chain.



The wires are hooked to different links, so they can be pulled through with less effort

the effect being to taper off the usual "head" where the wires connect to the tape. This allows the group to be drawn more easily around bends. The chain is pulled with the usual tape.—G. A. L.

AT THE suggestion of a heating contractor, the U. S. Bureau of Standards recently tested pipe joints made with lead filings from a coarse rasp in comparison with the red lead and white lead pastes ordinarily used. Joints made with the lead filings uniformly withstood a pressure of 8,000 lbs. without leaking, yet could be unscrewed easily. Similar joints were made with lead paste and only half of them remained leak proof at that pressure.

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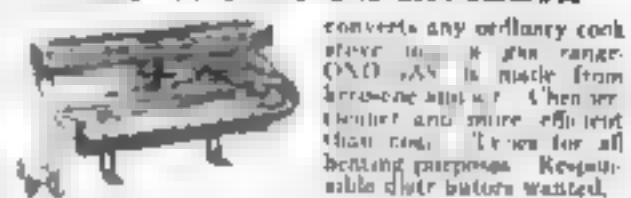
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Prices 50c. \$1.00. POST-PAID. Johnson Smith & Co., Dept. 583, Racine, Wis.

Better Shop Methods

Special Driving Arbor for Light Lathe Work

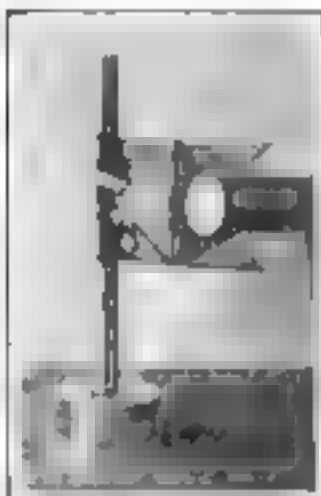
FOR light lathe operations where the cut is not heavy enough to loosen the live center in the spindle, the arbor shown will sometimes serve conveniently. It permits machining on either side of the work without interference from a driving plate. Furthermore, in finishing and polishing there is no danger of being caught by a set screw. —FRANK N. COAKLEY.



No dog is needed with this handy arbor.

Self-Setting Gage for Marking Centers of Shafting

SHAFTING held in vee blocks on the layout plate can be centered in no time with the tool illustrated. It consists of a round base into which is fixed a rod. Sliding on the rod is a vee having a marking point at right angles. In use, the vee is adjusted to fit the shaft and the sliding portion clamped with the thumb screw. Then the tool is turned so that the marking point can scribe a center line. H. MOORE.



Setting the gage to the correct height by means of the vee.

A Safe Lifting Bar for Use in Shop or Shipping Room

IT IS possible both to simplify and make more safe the moving of heavy parts around the shop or shipping room through

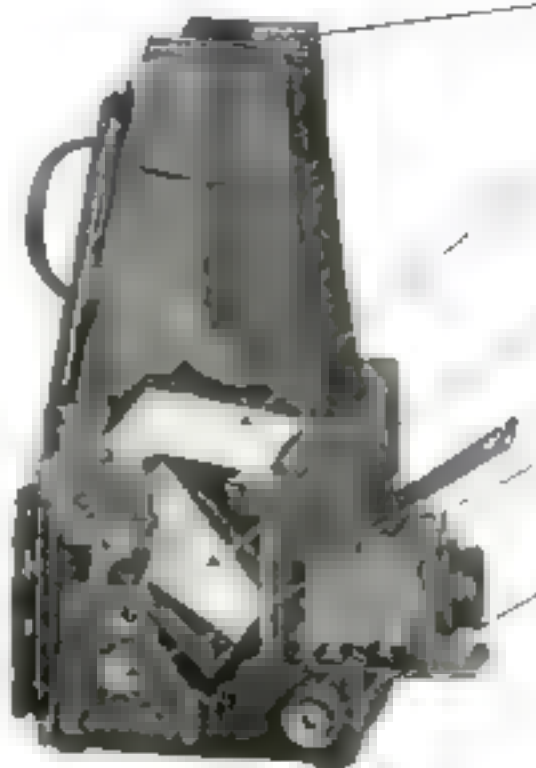
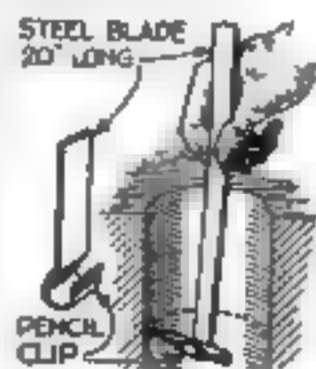


A heavy lifting bar of this type often serves better than ordinary crowbars and blocking.

the use of a lifting bar of hardwood with an iron shoe fitted on the end. This takes the place of a crow bar and loose blocking, which are apt to slip.

Handy Pencil Holder for Inaccessible Places

A LIGHT piece of band-saw steel formed with a hook on the end makes a good holder for a pencil or crayon when marking in inaccessible places. —GEORGE W. ROYER.



Look into the focusing hood and you see a reflected image of the subject, right side up, full picture size.

When the image on the ground glass is sharp, the focus is sharp; if composition is correct on the ground glass it will be correct on the picture.

This tilted mirror reflects the image to the ground glass above. When the exposure lever is pressed the mirror swings upwards out of the way, releasing the shutter curtain.

Focal plane shutter has speeds of 1/8 to 1/1000 of a second and passes about one-third more light than does any other type of shutter.

Focus is under easy control here until the instant at which the left thumb trips the exposure lever.

Examine a Graflex

and you will see why Graflex pictures are so sharp and clear. The reflecting mirror makes exact focus sure. The shutter's range and the lens's speed let the exposure record the subject in detail.

f.2.5 A new model—3 1/4 x 4 1/4 Revolving Back Graflex, Series C—is equipped with Cooke Anastigmat f.2.5, over three times as fast as the fastest lens ever before offered on a Graflex. This camera can make sensational instantaneous pictures in rain or under shade or indoors. Price \$260. Other models, \$59.50 up. Visit a dealer or write to Rochester.



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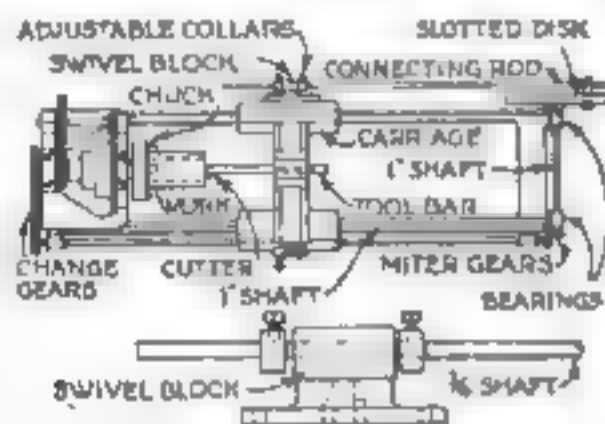
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Better Shop Methods

Adapting an Old Lathe for Cutting Oil Grooves

SHOPS handicapped by not having a regular oil-grooving machine, can arrange an old lathe to do this work acceptably.

After the apron has been removed from the carriage, a special swivel block is attached to the rear. The lead screw is taken off and in its place a small shaft is substituted. At the end of this shaft is a miter gear, meshing with a similar gear on a short shaft at the end of the bed. In the case of a very long machine, this shaft could be put through holes made in the bed. On the back end of this shaft there is a slotted disk, similar to a disk used on a shaper or slotter, so that different



How an unused lathe may be fitted to cut figure 8 oil grooves quickly and economically

lengths of stroke can be obtained. A connecting rod runs from the crank pin to the swivel block on the rear of the carriage.

The length of oil groove cut depends on the throw of the crank, which is varied by moving the crank pin out or in. The change gears are provided so that the pitch of the groove may be varied.

For example, if the crank makes one revolution to one of the spindle, the resulting groove will be a loop, not crossing itself at any point. If the spindle is geared to make two revolutions to one of the crank, the groove will cross itself at one point, in the center of the length of the groove. By providing play between the adjustable collars, where they make contact with the swivel block, the tool will dwell at the end of the stroke, thus making an additional variation in the shape of the groove. The contour of the groove is governed by the shape of the tool, which must be ground with plenty of clearance. If desired, a special rigid tool block may replace the compound rest.

—H. L. WHEELER.

Bacon Grease Is Valuable As a Cutting Medium

AFTER my wife has fried bacon or ham, she pours the grease into a tin can and saves it for me. When the can is full, I take it to the shop and she starts to fill another. By this means I keep well supplied with the finest kind of cutting medium to use on drills, taps and dies. It is better than oil, for it will flow only as heat is generated and goes right to the point where it is needed.

When tapping, I merely dip the tap in the grease, and that is sufficient for the entire operation.—H. M.

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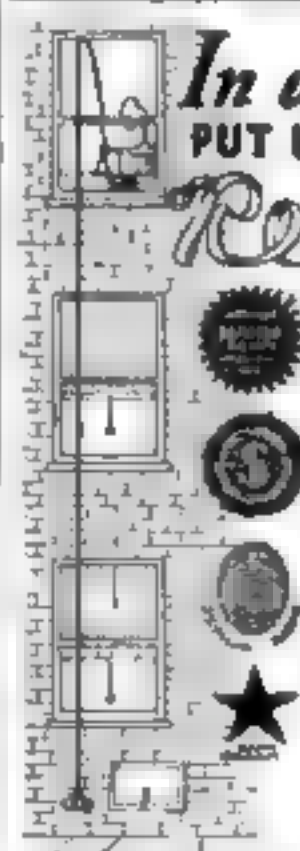
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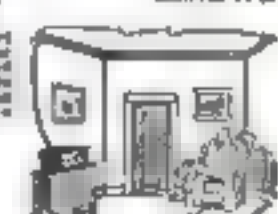
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RADIO PROTECTION



A Test in Time Saves Many an Hour of Poor Reception!

Save off impending troubles in your set by knowing exactly what's what within your batteries and tubes. It only takes a moment to find out with the use of Sterling Inspectors. It takes only a few minutes per week to keep your set in first class operating condition with Sterling Care-Takers.

THESE INSPECTORS ARE A NECESSARY PART OF YOUR EQUIPMENT

and their cost is small compared to the troubles they avert. You don't need to be radio-wise to use them; anybody can get results, save time and money too.

At most all radio stores

THE STERLING MANUFACTURING CO.
Cleveland, Ohio



Charge Indicator

Shows instantly whether your 5-Battery is fully charged. After a week's home use it will operate before recharging is necessary and it will have been charged enough. The device costs only the less, quick easy to use.

Price \$2.00

Tube Tester

This little meter is used to test vacuum tubes. It indicates whether a tube is good, fair or bad. It is a simple device for the home or the shop.

Price \$7.90



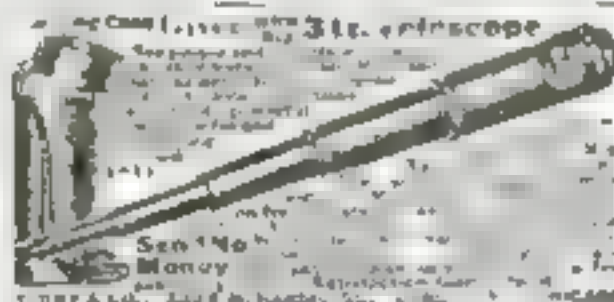
Check up on these Care-Takers and Inspectors

Are you fully protected?

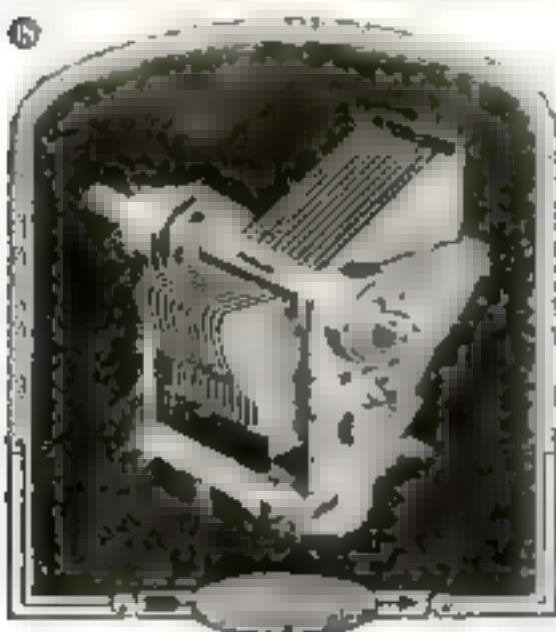
Battery Meters
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Battery Chargers
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Choose a STERLING device from the above list!

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The New Hammarlund "MIDLINE" Condenser Will Improve Your Radio



Avoids Crowding at Any Part of the Scale

It gives greater separation of low-wave stations than the old "SLC" type and greater separation on the high waves than the recent "SLF" type.

In addition to the many famous features in previous Hammarlund models, the "MIDLINE" has ball and cone bearings and a full-floating rotor shaft. This shaft may be removed and a longer shaft inserted for coupling to other condensers in tandem.

Made in all standard capacities—single, dual, and triple.

Sold by the better dealers

HAMMARLUND MANUFACTURING CO.
424-438 W. 33rd Street, New York

For Better Radio

Hammarlund
PRECISION PRODUCTS

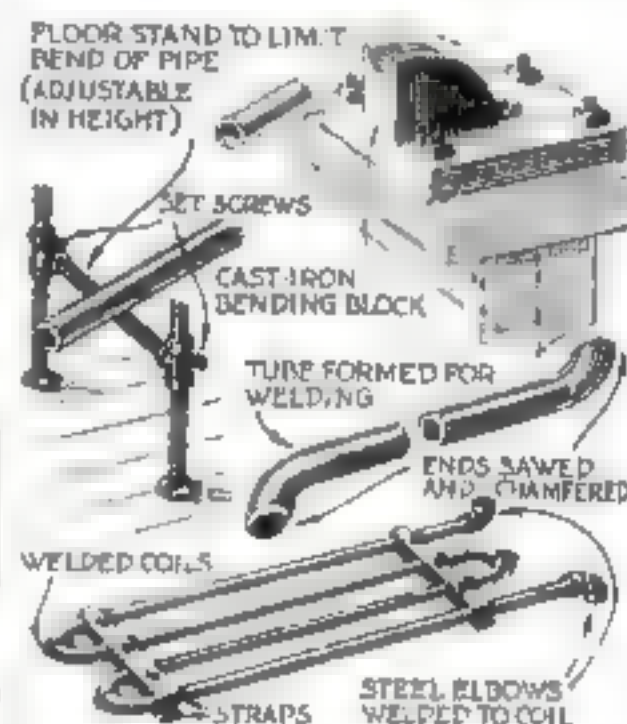
Better Shop Methods

Welding a Pipe Coil for High Pressure Work

By A. S. JAMIESON

SINCE welding methods have been developed to the point where good welds can be made with certainty by a skilled welder, there is a growing tendency to do away with screwed fittings in high pressure work. This is of especial importance in heating coils used in chemical process tanks where leakage would contaminate the product.

Such a coil is shown in the illustration. It is made of 1 1/4-in. pipe, or, preferably, seamless steel tubing. The tubes are all cut to the same length and bent with the cast-iron bending block shown, which is cast to fit the pipe, and with the desired radius. This is secured to the bench, and



The tubes are cut to length, bent uniform & chamfered, and welded carefully end to end.

on the floor in front of the bench, is a pipe stand to act as a gage for the bend.

It is best to allow some extra length to saw off the ends of the pipe to a gage after bending in order to get a true fit, and a good even chamfer. When all the pipes are bent and chamfered, they are clamped together with straps and welded into what amounts to a one-piece pipe.

The finished work should be tested with hydraulic pressure, usually with the aid of a boiler test pump, to about 500 pounds.

Welding pipe is work that calls for the utmost skill in the welder's art to insure tight work. Before trying such a job a welder who has never worked on pipe should practice on some short lengths and test his work to make sure that he can do the large job satisfactorily.

A COLLET chuck for holding a small drill or a length of drill rod in a lathe may be made from a discarded lathe center. Square the end and bore and ream it to take a large taper pin. Then drill a hole of suitable size in the pin. Remove the pin and make one split lengthwise. The pin, with the rod or drill inserted, is tapped into the hole in the center.—L.B.

**30
DAYS
FREE
TRIAL**

7 Tube Set Single Dial Radio



The Metrodyne

ONLY ONE DIAL TO TUNE

Wonderful Offer Direct from the Factory!

A perfect working, single dial control, 7 tube receiver. And just to prove our claims, we will ship it to your home for **30 days' free trial**. Test it under all conditions. Test it for distance volume and tonal quality — and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

Retail Price

\$75

Completely Assembled

**Big Discounts
to Agents and Dealers**

BIG PROFITS

TO AGENTS AND DEALERS

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon below—or a letter—for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. Approved by America's leading radio engineers. Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet. Artistically gilded genuine Bakelite panel, nicked piano hinge and cover support. All exposed metal parts are beautifully finished in 24-k gold.

An easy set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, 1,000 to 3,000 miles on loud speaker! The Metrodyne Super-Seven is a beautiful and efficient receiver and we are so sure that you will be delighted with it that we make this liberal **30 days' free trial offer**. You to be the judge.

Mail COUPON Below!

**Let us send you proof of
Metrodyne quality**

F. L. Warnock, Greentown, Ind., writes: "I received the Metrodyne in good shape and am much pleased with it. Got this one 2,000 miles away."

G. J. Walker, Mariposa, Calif., writes: "Received my Metrodyne Single Dial set O. K. I believe that I am the only set in the world to be received so perfect. I had no trouble in tuning in the sets enough to satisfy anyone, so you will please send me another set."

Ray Bloch, San Francisco, Calif., writes: "Very often we travel from New York to the Hawaiian Islands quickly — from station to station — by means of the little unit knob which operates the electrically lighted dial. The Metrodyne Single Dial Set is much easier to operate than any radio set I've ever seen."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer**.

METRO ELECTRIC COMPANY

2161-71 N. California Ave., Dept. 157
Chicago, Illinois

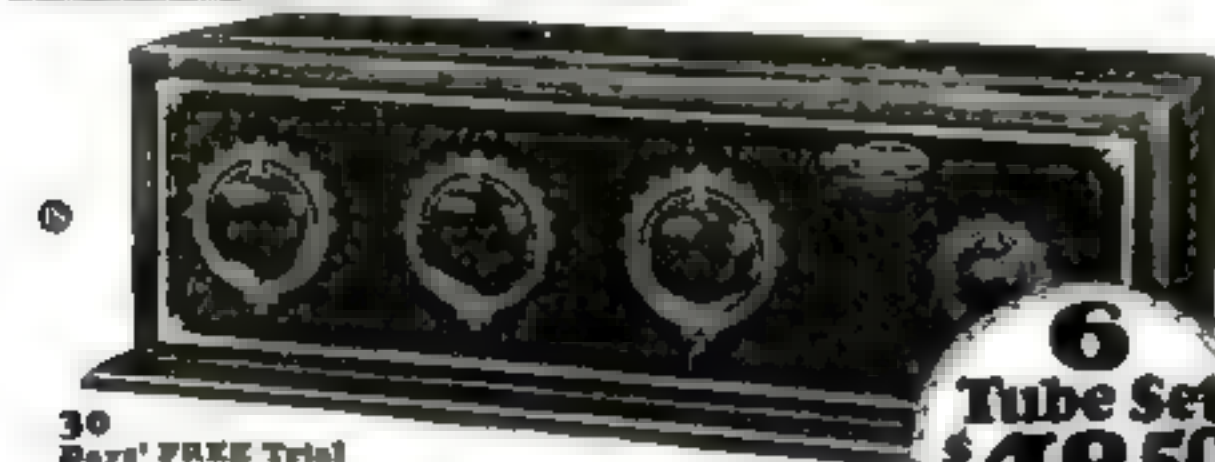
Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer**

Name _____

Address _____

If you are interested in AGENT'S proposition, place an "X" in the square ☐



**30
Days' FREE Trial**

Metrodyne Super-Six

Another triumph in radio. Here's the new 1936 model Metrodyne 6 tube set. Single dial control, 6 tube receiver. Approved by America's leading radio engineers. Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet. Artistically gilded genuine Bakelite panel, nicked piano hinge and cover support. All exposed metal parts are beautifully finished in 24-k gold. Instantly on same dial readings every time. No guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air, I tuned in seventeen out of town stations — including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer**, which gives you the opportunity of trying before buying.

METRO ELECTRIC COMPANY

2161-71 N. California Ave. • Dept. 157 • Chicago, Illinois

**6
Tube Set
\$48.50**

RETAIL PRICE

**Completely
Assembled**

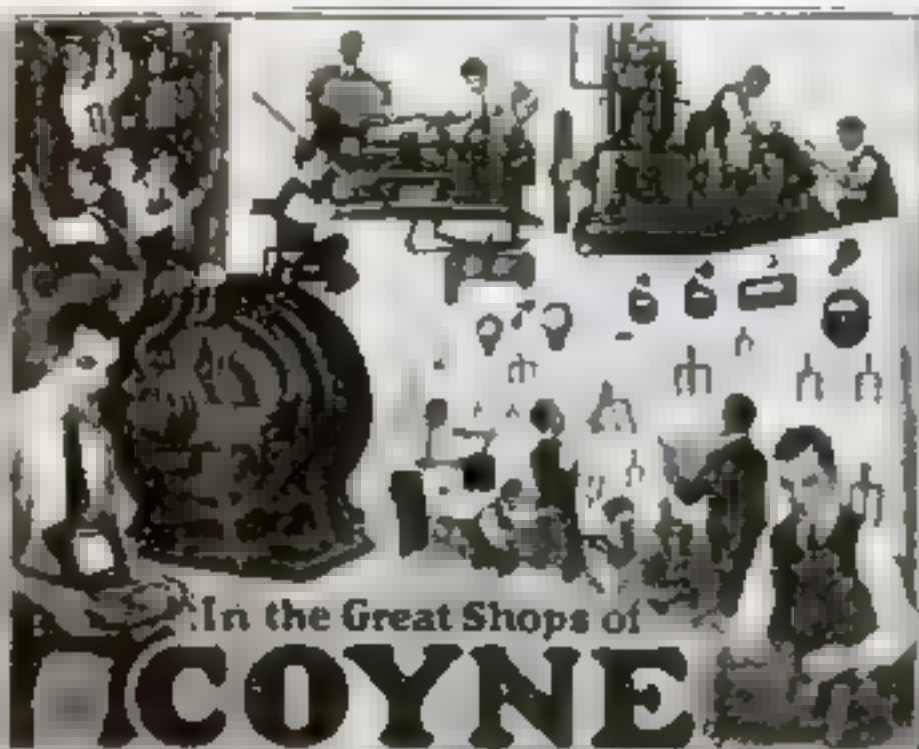
**MAIL THIS
COUPON**

or send a postal or letter for our proposition before buying a radio. Deal direct with manufacturer — **Save Money.**

Money Making Opportunities

for Readers of Popular Science Monthly

LEARN



EARN BIG PAY!

Many make \$200 to \$800 a Month

Why work for small pay? Why be satisfied to make \$5.00 or \$10.00 or even \$10.00 a week in a tiring job where you never know when you may get laid off? Do pleasant work, Be a Coyne Trained Electrician and learn to earn \$200.00 to \$800.00 a month or go in business for yourself and earn up to \$15,000 a year.

**12 Weeks At Coyne
All Practical Work, No Books**

I train you on actual Electrical Machinery, in 12 weeks at Coyne. I don't teach you a lot of useless theory. My training gives you useable knowledge on the same kind of machinery you will find in Power Houses, Plants and Industrial businesses.

**Free Railroad Fare to Chicago
When You Enroll**

For a short time I'll pay your Railroad Fare to Chicago, and besides I'll include Free my two big Courses, Auto and Radio Electricity.

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Complete Story**

I haven't space here to tell you the advantages of my training but I'll send **ABSOLUTELY FREE** my big new book with over 150 actual photographs and success stories of my graduates. It tells you all about my employment service after graduation and how you can earn your expenses while attending my school. **FILL OUT THE COUPON NOW AND MAIL IT AT ONCE.** You owe it to yourself to get the facts.

H. C. Lewis, Pres.
Coyne Electrical School
1300-1310 W. Harrison St.
Dept. 74-75
Chicago, Ill.
Don't let this chance to get all the facts. Send me that big handsome 12x18 book now. I'll return it as under no obligation and it cost you nothing to read.

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1300-1310 W. Harrison St.
CHICAGO, ILL.

ELECTRICITY

MAKE \$200 to \$800 A MONTH

\$25 in

CASH PRIZES

For the best letter of 170 words or less answering the question—

"What advertisement in the 'Money-Making Opportunities' Section interests you most—and why?"

we will pay on November 10th the following—

CASH PRIZES

First Prize	\$10.00
Second Prize	5.00
Third Prize	3.00
Seven Prizes of \$1.00 Each	7.00

First read every advertisement in the Money-Making Opportunities Section on pages 136 to 165. Pick out the one that interests you most and then write a letter—not exceeding 170 words—telling us why you find the advertisement you have selected the most interesting.

Entries for the contest will close on October 1st. The prize winners and their letters will be published in the December issue of POPULAR SCIENCE MONTHLY.

Address your letter to
Contest Editor

MONEY-MAKING OPPORTUNITIES
POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York

PRIZE WINNERS

In the August Contest

FIRST PRIZE \$10.00

Lucille Smith Des Moines, Ia.
(American School)

SECOND PRIZE \$5.00

R. W. Carr, Parkersburg, W. Va.
(National Salesmen's Training Assn.)

THIRD PRIZE \$1.00

John A. Dooms, St. Louis, Mo.
(Moler System of Colleges)

PRIZE WINNERS who receive \$1.00 each for their letters:

Nirhal T. Road, Los Angeles, Cal.
(Chicago Engineering Works)

W. H. Dyer, San Francisco, Cal.
(London School)

Paul Betharhender, West Point, Nehr.
(Coyne Electrical School)


Russell E. Lundgren, Forest Lake, Minn.
(LaSalle Extension University)

Will Thomas Withrow, Rochester, N. Y.
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Electrical Experts are in Big Demand!



L. L. COOKE
Chief Engineer

I Will Train You at Home for a Big Pay Job

5 Big Time Outfits to work with No Extra Charge



With me, you do practical work—at home. You start right in after your first few lessons to work at your profession in the regular way and make extra money in your spare time. For this you need tools, and I give them to you—5 big complete working outfits, with tools, measuring instruments, and a real electric motor—5 outfits in all.



It's a shame for you to earn \$15 or \$20 or \$30 a week, when in the same six days as an Electrical Expert you could make \$70 to \$200—and do it easier—not work half so hard. Why then remain in the small-pay game, in a line of work that offers no chance, no big promotion, no big income? Fit yourself for a real job in the great electrical industry. I'll show you how.

Be an Electrical Expert Earn \$3,500 to \$10,000 a Year

Today even the ordinary Electrician—the "screw driver" kind—is making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the Electrical Expert—who is picked out to "boss" the ordinary Electricians—to boss the big jobs—the jobs that pay \$3,500 to \$10,000 a year. Get in line for one of these "Big Jobs." Start by enrolling now for my easily learned, quickly grasped, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

Age or Lack of Experience No Drawback

You don't have to be a College Man; you don't have to be a High School Graduate. As Chief Engineer of the Chicago Engineering Works, I know exactly the kind of training you need, and I will give you that training. My Course in Electricity is simple, thorough and complete and offers every man, regardless of age, education or previous experience, the chance to become, in a short time, an "Electrical Expert," able to make from \$70 to \$200 a week.

Your Satisfaction Guaranteed

So sure am I that you can learn Electricity—so sure am I that after studying with me, you, too, can get into the "big money" class in electrical work, that I will guarantee under bond to return every single penny paid me in tuition, if, when you have finished my Course, you are not satisfied it is the best investment you ever made. And back of me in my guarantee, stands the Chicago Engineering Works, Inc., a two million dollar institution, thus assuring to every student enrolled, not only a wonderful training in Electricity, but an unsurpassed Student Service as well.

Free Book on Electricity



Pay Raised 150%

"I was a dumbbell in electricity until I got in touch with you, Mr. Cooke. But now I have charge of a big plant, including 600 meters and direct a force of 34 men—electricians, helpers, etc. My salary has gone up more than 150%."

GEO. ILLINGWORTH,
© Cahoon Road,
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I want to send you my Electrical Book and Proof Lessons, both Free. These cost you nothing and you'll enjoy them. Make the start today for a bright future in Electricity. Send in Coupon—Now!

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Send me at once without obligation your big Electrical book and complete details of your Home Study Course in Electricity, including your work and employment service plan.

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Occupation _____

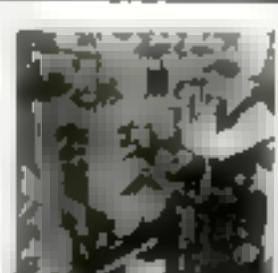
The "Cooke" Trained Man is the "Big Pay" Man!



\$700 in 24 Days

"Thanks to your interesting course I made over \$700 in 24 days in Radio. Of course, this was a fluke, but the average (but I run from \$10 to \$15 a day) profit every day as you can see what your training has done for me."

J. H. MCNAMEE
1716 26th Atlanta, Ga.



\$20 a Day
—for Schrock

"Use my home as a reference and demand to me as a business. The biggest thing I ever did was secure good employment. I am averaging better than \$200 a month from my own business now. I want to make it a success."

W. H. SCHROCK
Pomona, Ariz.

I Will Train You At Home To Fill a Big Pay Radio Job

"I give you all this apparatus so you can learn quickly at home the Practical Way"

FREE OF EXTRA COST



You Get All of This

All instruments shown here and others sent to all my students free of extra cost under short time special offer. Clip coupon now and get all about this big unequaled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work. You learn workmanship and get added confidence in your ability.

World Famous Training That "Pays for Itself"

My Radio course World-Famous as the training that "pays for itself." Make more money at 14 K. when you take up this plan. It's a course that will give you a chance to make spare time cash while you're working. I'll show you how—teach you the latest "dope" on the business and make it pay. My students who take a year to complete their course report 14 K. in 14 WEEKS as a result of this course—often two or three weeks after starting. Howard Lure, Friedman, Pa., made \$20 in 7 weeks during spare time. Ed H. Sultz, New York, Ark., writes, "While taking the course I earned in spare time about \$900." Earl Wright, Omaha, reports making \$400 in a short time while taking course—working at Radio in spare time. Sylvester Benson, Kaukauna, Wis., made \$500. These records not unusual—they mean a lot of hundreds.

Your Satisfaction Guaranteed

We who know the results this practical, tested training gets—the increased earnings it has brought to men everywhere—stand behind it all the way with a signed guarantee bond that we give you when you enroll. On completion if you're not satisfied in every way, you get back every cent you've paid for this offer—you yourself are the only judge. It's your big chance for one of the bigger Radio jobs. NOW for my Big FREE BOOK and proof! No obligation.

If you're earning a penny less than \$50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at \$25 or \$35 or \$45 a week, when you could earn \$50 to \$250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you?

Earn \$50 to \$250 a Week—

RADIO EXPERTS IN BIG DEMAND

Radio needs trained men. Get into this new live-wire profession of quick success. It's the trained man, the Radio Expert, who gets the big jobs of this profession—paying \$75, \$100, \$200 a week and up. Every day N. R. I. trained men are taking good places in the Radio field—men just like you—their only advantage is TRAINING. You can prepare just as they did, by new practical methods. Our tested clear training makes it easy for you. Big Free Book contains all the proof.

You Learn Quickly In Spare Time

So sure am I that I can train you successfully for a better future in this new Big-Pay profession, that I guarantee your training with a money-back bond. Lack of experience or education won't hold you back—common schooling all you need to start. You can stay home, hold your job, and learn quickly and pleasantly in your spare time. My practical, helpful methods enable you to start RIGHT AWAY toward one of the bigger Radio jobs paying \$50 to \$250 a week. No delay, no losing time from work—no scrambling or scraping to get your training.



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"Accepted a position with the Chicago Daily News Station WMAQ. MY INCOME PRACTICALLY DOUBLED, thanks to you. I handle all consultation, also do operating. Your course taught me not only the theoretical but also the practical knowledge that makes my work easy for me." Keith Kimball, Station WMAQ, Chicago, Ill.

Get This FREE BOOK

Most amazing book on Radio ever written—full of facts and pictures—tells all about the great new Radio field, how we prepare you and help you start. You can do what others have done. GET THIS BOOK. Send coupon today—no obligation.

J. E. SMITH, President
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Dept. M.T.-9, Washington, D. C.

\$70 in One Day For T. M. Wilson

"I am in business for myself and RECENTLY MADE \$70 in ONE DAY. I was an electrician of rich experience, occupying a splendid position as telephone superintendent when I enrolled with you believing it would open up greater opportunities—haven't been disappointed. Estimated Radio will be worth tens of thousands of dollars to me in next few years." T. M. Wilson, Belle Island, Newfoundland.

EMPLOYMENT SERVICE TO ALL GRADUATES

(Originators of Radio Home-Study Training)



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Dear Mr. Smith—Without obligating me in any way send me your free book "Rich Rewards in Radio" and all information about your practical, home-study Radio Course.

Name..... Age.....
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INVENTIONS perfected drawings. Blue prints. Patents made. J. A. Chapman, Manchester, Ala.

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DETECTIVES Work home or 175 St. Experience unnecessary. Write George Wagner, former Government Detective 19049 Broadway, N. Y.

ALL ADVERTISERS Ask today for a copy of the "Quick Action Advertising Rate Folder." It contains some very important facts which will prove interesting and valuable to you. It also tells How You Can Use Popular Science Monthly Profitably. You'd like to know whether or not a drop in inquiry to a square inch should Advertise. Popular Science Monthly, 250 Fourth Avenue, New York.

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FOR SALE Small Automobile School located in Chicago. A stage of training for girls. Two class cars available. Write J. J. Hays, 638 W. 11th St., Chicago, Ill.

FOR SALE A very good and profitable business is available and profitable. For quick sale \$2,500.00. Write for money. Address P. J. Lloyd, 6380 West 12th St., Chicago, Ill.

FOR SALE No. 2 Remington & Sharps Miller Machine. Photo. Camera & Trip. In Chicago, Ill.

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HOT WATER ON TAP Make your own Auto-Heater. Write John Kuehn, 1400 N. Chicago, Ill.

RENTAL A small house with 3 bedrooms and 2 bathrooms. Rent \$100.00 per month. Write for details. 1400 N. Chicago, Ill.

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Help Wanted

RENTAL A small house with 3 bedrooms and 2 bathrooms. Rent \$100.00 per month. Write for details. 1400 N. Chicago, Ill.

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To Keep You in Razor Blades for Life!

THIS amazing new invention upsets all established shaving tradition. Within 60 days it will revolutionize the before-breakfast habits of over a million American Shavers! KRISS-KROSS marks such a radical advance in new shaving comfort and economy that it deserves to be classed as much more than a stropper. It's a super-stropper—a blade rejuvenator! Almost literally, it makes a new blade out of an old one every day—makes hundreds of keen, quick shaves blossom where only one grew before. Until you've seen KRISS-KROSS—fitted its sturdy, nicked smoothness into the palm of your hand, and tested its uncanny ingenuity, you'll never know how really sensational this introductory offer is!

Amazing Features

KRISS-KROSS employs the diagonal stroke, same as a barber uses. Never before has any one captured the secret of successfully reproducing this stroke automatically. Eight "lucky leather grooves" do the trick in 11 seconds with a precision it takes a master barber years to attain.



GET THIS MYSTERY RAZOR FREE!

Most astonishing razor you ever saw. Really a razor in one. Adjustable to any shaving position. Flip of finger makes it straight or T-shape in a lift. Novel feature gives sliding instead of pulling stroke. Simply slips through the toughest crop of whiskers. Nothing like it ever on the market before. A razor you use FREE in introduction KRISS-KROSS super-stropper. Limited offer. Find out about it today.

But that's not all. KRISS-KROSS embodies still another feature that has hitherto baffled mechanical reproduction. It strope from heavy to light. It's absolutely uncanny how the strokes grow lighter and lighter until an adjustable, automatic jig flies up and notifies you that the blade is ready—ready with the *keenest cutting-edge steel can take*.

No wonder that this super-stropper prolongs the life of any-make blade—single or double edge, for weeks, months and years! Think what it means! No more bother about remembering to buy new blades! No more "taking" with dull ones! KRISS-KROSS, coupled with my startling offer below, solves your blade problem for all time. Keen, velvet-smooth shaves forever. And think of the economy!

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And now for my amazing offer! To introduce KRISS-KROSS stropper during the next 30 days I am giving with it, free, a new kind of razor. This unique razor, with 5 special-process blades, completes

the outfit with which I guarantee to keep you in razor blades for life!

Here's how the plan works: I give you the blades and keep renewing them with KRISS-KROSS super-stropper. If one of them goes back on you for any reason except rusting or nicking, return them and I'll re-sharpen or replace them with new ones. No strings. No red tape. I give you a written guarantee in writing. It's an absolute agreement to KEEP YOU IN RAZOR BLADES FOR LIFE!

SEND FOR FULL DETAILS

Write for free information on this astounding new invention and introduce my offer. KRISS-KROSS is never sold in stores. You deal direct with me or my authorized representative. Send for description and full details of this limited offer. It's even more sensational than I can tell you in this one space. No obligation! Just clip and mail the coupon today.

AGENTS MAKING \$30-\$66 A DAY

Make big money with KRISS-KROSS! Free razor boosts sales amazingly. If long made \$400 a day. C. E. Canfield made \$125 a day in 10 days on a stage. \$300 a month. Every man who signs up at 11 A.M. every week. 10 P.M. and 11 P.M. every week make \$40 a day extra in my showing KRISS-KROSS to friends and fellow employees. 8 hours made \$154 extra working evenings 3 weeks. Most wonderful sales plan ever originated. Get details at once. Check bottom of coupon and mail it tonight!

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Without obligation please send me full details of your special introduction offer to keep me in razor blades for LIFE. Also send the full description of KRISS-KROSS stropper and FREE adjustable razor.

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Will We Hop the Ocean on Floating Islands?

(Continued from page 144)

minimizes the possibility of danger on his proposed air route.

"On an average you would travel two million miles in a triple-motored airplane," he said, "before you would be confronted with the necessity of making a forced landing. Anyone who has traveled in airplanes at all would not be appalled by the prospect of making a four-hundred-mile flight over water, and by my plan a trip to Europe would be only a succession of four-hundred-mile flights punctuated by stops on safe, stable, comfortable landing stations from which the journey would be resumed on planes that had just emerged from the machine shop in tiptop condition.

"MY proposal may seem revolutionary according to existing standards of transportation, but so has every new development in transportation seemed at first. People who were accustomed to travel by stagecoach looked askance at the railroad. Steamships frightened people who thought nothing of undertaking an ocean voyage on a sailing ship. It is only a few years ago that people feared to ride in automobiles, and the airplane is still an object of terror to many. The transition from one method of transportation to the next, however, gradually was accomplished.

"It is my belief that the trans-Atlantic airplane service I propose will establish itself in exactly the same way. People will see that with thirty-four-hour service to Europe available, they cannot afford to use steamships which require six or seven days for the same trip. It is merely a question of establishing the service, for, once established, its patronage will take care of itself.

"In this connection four groups capable of financing my scheme for ocean transit have become interested in it. As a preliminary step, and supplementing the tests I have made with the model, it is planned to construct a seadrome, somewhat smaller than the size I have indicated for ocean traffic, and place it off the coast where it might be subjected to an actual sea test."

THESE are the high spots of the amazing plan by which this inventor proposes to banish the ocean barrier that separates the Western and Eastern Hemispheres. A suggestion to dot the waters of the Atlantic with man-made islands at first glance seems bizarre, even absurd. Consider, though, that it is made by a distinguished engineer who for twelve years has instituted an average of twenty-five important developments a year, representing millions of dollars, for one of the largest manufacturing corporations in the world, and who has been a practical experimenter in aviation since the birth of the science. Moreover, he shows by mathematical calculations and working models exactly how the thing can be done.

Maybe a few years hence we'll be able to run over to Europe on week-end trips whenever we feel like it!

JAMES G. VINCENT



WALTER P. CHRYSLER

J. R. HALL



How Prominent Automobile Men Got Their Start

VINCENT, CHRYSLER, RICKENBACKER, HALL, WALKER and scores of other prominent automobile executives rose from the ranks. What are the opportunities in this field today?

THE swift development of the automobile is one of the amazing romances of American industry. The impractical toy of thirty short years ago has become the most indispensable means of modern transportation.

The automobile business was built by men who rose from the ranks and there are even greater opportunities today than there were thirty years ago. For the more automobiles there are, the more opportunities there will be for ambitious men.

No other educational institution has trained or is training so many men for success in the automobile field as the International Correspondence Schools. Here are just a few former I. C. S. students who have made good in a big way:

JAMES G. VINCENT—Vice-president of Engineering, Packard Motor Car Company. Designer of the Packard "Twin-Six" and co-inventor of the Liberty Airplane Motor.

R. V. ("Eddie") RICKENBACKER—America's flying ace; Vice-president and Director of Sales, Rickenbacker Motor Car Company.

WALTER P. CHRYSLER—Formerly President

and General Manager of the Buick Motor Car Company; First Vice-president in Charge of Production, General Motors Corporation. Now Chairman of the Board of the Chrysler Corporation.

MAX H. THOMAS—Supervisor of Inspection, Marmon Motor Car Co.

HOWARD WALKER—Chief Engineer, Chandler Motor Car Co.

HERMAN T. KRAFT—Chief Aeronautical Engineer, Goodyear Tire and Rubber Co.

E. J. HALL—Vice-president and General Manager, Hall-Scott Motor Car Co., Co-inventor of the Liberty Airplane Motor.

J. R. HALL—Vice-president and Factory Manager, Chandler Motor Car Company.

JOHN MOORE—Designer of the famous Anzani Engine.

If the International Correspondence Schools can smooth the path to success for other men, they can help you. If they can help other men to go forward to better jobs or to success in businesses of their own, they can surely help you too.

At least find out how by marking and mailing the coupon printed below. It doesn't obligate you in any way and it takes only a few minutes of your time, but it may be the means of changing your whole life. It pays to take a course of home study with the world's largest correspondence schools.

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Are You Afraid to Face the Truth About Yourself?

There are occasions in the life of every man when he realizes how miserably he has fallen below what others had expected of him and what he had dreamed for himself. The "big" man faces the truth, and does something about it. The "little" man finds an excuse for his failure, and does nothing. What are your answers when you ask yourself questions like these?

Am I not drifting along aimlessly?

What, after all, is my purpose in life?

Am I trusting too much to chance to bring me success?

What is my greatest weak point?

Is it lack of will, poor memory, mental laziness, mind-wandering, or what?

Am I "fished" by life, am I a "quitter"?

What can I do, now, to "find myself"?



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Pelmanism originated in Great Britain. Members of the royal family, leading statesmen, distinguished military and naval officers, with whom it has been associated, with its aid and guidance have achieved success in business, in the professions, in the sciences, and in the arts. It has been the basis of the education of many of the world's great leaders.

When the knowledge spread to America the great story was repeated. Hundreds of industrial and business men, of all ages, classes, and professions, have adopted and are practicing Pelmanism to help themselves and their families.

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When people like General Sir Robert Baden-Powell, Judge Ben B. Lindsey, Frank P. Wilson, Captain General Sir Frederick Munnell, Admiral Lord Beatty, T. P. O'Connor, H. R. H. Prince Charles in Sweden, General K. J. F. Gough, and Sir Harry Lambton and a host of others regard Pelmanism as the best thing in the world, can you afford to ignore its possibilities for you?

We will be glad to send you, without charge, a book called "Pelmanism: Mind-Training." This is the complete story of Pelmanism, what it is, what it does. It is filled with a series of tests and exercises which will show you where you have been completely made over by Pelmanism. To send for this book involves you in no obligation.

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New Wonders of Our Sun

(Continued from page 13)

turbating periods have their compensations. Sunlight now is being advertised as one of the greatest curative agents at the disposal of man. The ultra-violet rays are known for their health-giving properties, and have been found particularly beneficial in the treatment of rickets and tuberculosis. Experiments have revealed that during his periods of activity the sun is unusually generous in his distribution of the ultra-violet rays.

DESPITE the distance that separates us from the sun, he can't hide many of his secrets from us. We know, for example, just what he is made of. And all of his chemical constituents have been found on earth with the exception of one, coronium, which is revealed during an eclipse. The fact of this duplication gave rise to a theory recently expounded by Professor John A. Snyder, of the Philadelphia Observatory, that the earth is an offshoot of the sun.

Away back a few billion years or so the sun, he tells us, was much more active than at present. A great boiling motion is kept up in the interior even now—the heat at the center is estimated to be around 70,000,000 degrees—and there is reason to believe that in its youth the sun was much hotter and more active. When the earth came into being, Professor Snyder thinks, there was an eruption similar to that which occurs in many homes daily at breakfast time when the housewife lets the coffee boil over. The sun got beyond its boiling point and a spot, or volcano, formed on its surface. The force was so great that a small portion of the interior shot out and went sailing in a curve through space, much as the coffee shoots up and over the side of the pot.

ON AND on this segment of gas flew, gradually slackening speed and describing a great arc as the normal attraction of the sun worked to offset the force of propulsion. When the particle had reached a distance where the two forces were equal, it lost its motion away from the parent and continued on its curve. Gradually it cooled, formed a crust and settled down to the task of making itself habitable for humans.

Professor Snyder believes there was a recoil when the earth was shot off, and that a hole was torn in the opposite side of the sun's outer layer. Another segment was tossed out, becoming in time the planet Venus.

It really seems a shame to let the sun's energy go to waste. It is estimated that the amount of heat generated every second has a mechanical equivalent of 20,000 billion horsepower, sufficient to do all the work of the world. If there were only some way in which that energy could be harnessed we should not have to bother digging coal and drilling oil wells. Just snap on a switch and the sun would do the rest.

Our knowledge of this great orb would be much greater were it not for the fact that we have, on the average, only a minute or two a year. (Continued on page 149)



Three Years Ago \$40 a Month

—now heads his own business

In 1935 J. H. Bryson, now head of the Bryson Mordley Manufacturing Company, Fayetteville, Tenn., was clerking in a grocery store at \$40 a month. Today he is president and proprietor of the firm which bears his name, doing a million dollar business. "I had it not been for LaSalle and the self-confidence and inspiration which came from the knowledge secured from your 'Ten Years' Promotion' I would still be working as a grocery clerk or somewhere in this same channel. Nothing I could say would express the gratitude I feel toward LaSalle for my training."

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POPULAR SCIENCE MONTHLY
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New Wonders of Our Sun

(Continued from page 148)

in which to study it carefully. That is during an eclipse. Only then is the corona, an immense halo many thousands of miles in diameter, visible. It was during one of those momentary periods that the existence of helium was discovered. Scientists then succeeded in manufacturing helium, and eventually it was discovered on earth.

The corona is irregular in shape. Mountains of leaping light which form the outer edge reach heights of 35,000 miles and more. It is believed these prominences have a direct connection with the sun spots, hence the eagerness with which they are examined.

AN ECLIPSE, as you know, results when the moon gets between the earth and the sun. Were it not for a peculiar coincidence in the mathematical scheme of the heavens, eclipses would be of little value to the astronomer, as far as observation of the corona is concerned. The diameter of the sun is 400 times that of the moon, but its distance from the earth is also about 400 times that between earth and moon. The result is that when the moon passes directly across the sun's face the latter is completely obscured to persons whose location on the earth's surface is in the resultant shadow.

Just try this little experiment, and you'll see how it works. Your radio cone speaker, a dish pan, or plate can be used to represent the sun. Cut a circular disk of cardboard one inch in diameter to represent the moon. Now, assuming that your speaker or plate is eighteen inches in diameter, pace off eighteen feet from it and hold the disk before one eye, closing the other. Extend it slowly in the direction of the speaker until you have reached a point where the edge of the latter begins to appear. If you will have another person measure the distance from your eye to disk you will find it is exactly one foot.

THAT experiment represents a total eclipse. There are two other kinds—annular and partial. If, from the place where you have secured a total eclipse, you move your arm still further out in the direction of the speaker, you will be able to make out the rim. That illustrates an annular eclipse, while a partial eclipse can be demonstrated by moving your hand a little to the right or the left, so that one side of the speaker is visible while the other side is concealed.

Scientists travel thousands of miles and spend months in the erection of great cameras just for a view of an eclipse that may last only a moment or two. Universities and scientific societies spend many thousands of dollars in equipment. It is estimated that the cost of each eclipse expedition is about \$10,000 a minute.

When it is all over the photographic plates are developed and examined carefully for new signs. If one little bit is thereby added to our knowledge of the sun these investigators feel well repaid for their time and trouble.

Meanwhile the sun beams down, seeming to indulge himself in a sardonic smile at the puny efforts of men to discover his source of energy.



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America's First Great Experimenter

(Continued from page 13)

are "warming, dieting, and bracing." His suggestions, made in an era of "copious bleeding," all point toward today's theories of preventive rather than curative medicine—a typical instance of his position in advance of his age.

Great as was his interest in the other phases of science, Franklin always displayed a lively enthusiasm for the social sciences, particularly where they touched upon the sciences of political economy or of government. Some of his comments on population are particularly interesting in the light of today's knowledge. Consider this one:

"If in Europe they have but four births to a marriage, we may here, in America, reckon eight."

"Now (1751) one million English souls are in North America. This million, doubling once in every twenty-five years, will in another century be more than the people of England."

Similarly, his views on immigration show amazing foresight.

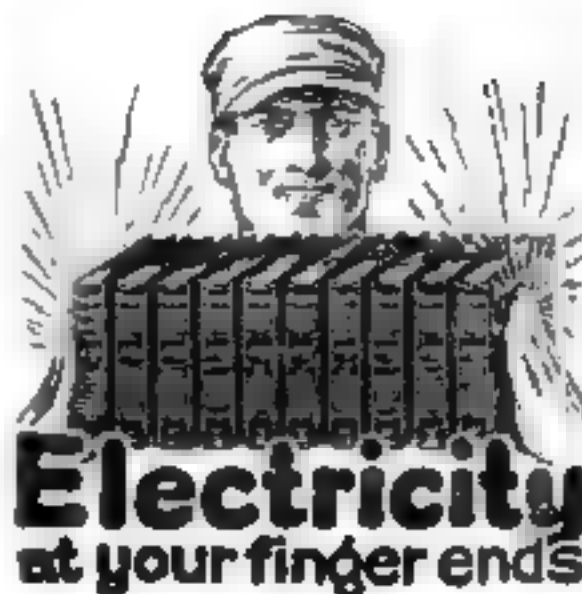
"MANY persons," he wrote, "have expressed their desire of transporting and establishing themselves in North America, but who appear to have formed, through ignorance, mistaken ideas and expectations of what is to be obtained there. . . . It may be useful, to prevent inconvenient expense and fruitless voyages, by giving some clearer account. . . ." Such a paragraph might easily be included in the remarks of any immigration official today.

But he remained thoroughly human, in the midst of all his higher branches of learning. At any moment he was apt to set himself some such question as, "I am about courting a girl I have but little acquaintance with. How shall I come to a knowledge of her faults, and whether she has the virtues I imagine in her?" To which he suggests the answer: "Consult her, among her female acquaintances!" No modern psychologist offers more.

HE WAS by no means always right in his conclusions. Thus he did not recognize the true nature of phosphorescence in sea water, but linked this up in his mind with the sea as the home of lightning. However after he had, in his careful way, examined sea water under a microscope and seen its myriad organisms, he was willing to accept a new theory. This was characteristic of him.

Something that seems much less characteristic is that he was for a time a soldier. Almost anyone would think of him as distinctly a man of peace. Yet when a Philadelphia regiment of militia was dispatched to fight the Indians, Franklin in spite of some disinclination, rode at its head as Colonel.

What is more, he soon showed that a certain amount of military science was included among his attainments. Distributing his detachments, he built several forts with palisades and moat trenches, with loopholes and gun emplacements. As the axes began felling the necessary trees, he (Continued on page 151)



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America's First Great Experimenter

made a point of noting that it took "six minutes by the watch" for two men to bring down a pine "of fourteen inches diameter." And that he was equally careful in not neglecting the personnel of his command is shown by his method of getting men to come to prayers.

The regimental chaplain, finding his audiences small, complained that the enlisted men were not punctual. Colonel Franklin had noticed that they were, however, very punctual when the allowance of rum was served out. "Perhaps," he said to the chaplain, "it is below your dignity to act as steward of the rum. But if you were to deal it out, and to do so only after prayers, you would have all the men about you." The experiment was tried and, says Franklin, "never were prayers more generally and more punctually attended. I thought this method preferable to the punishment inflicted by military law for non-attendance."

ANOTHER public act of his justifies his lifelong application of psychology and proven his absolute mastery of unequivocal, exact language. This occurred in 1770.

We have just celebrated the centenary of the death of Thomas Jefferson and the sesquicentennial of his masterpiece, the Declaration of Independence. Jefferson's original rough-draft was examined for the first time under a microscope when President Harding ordered the smooth, official copy moved from the State Department to the Library of Congress for public exhibition. Then Franklin's unsuspected share in the historic document was revealed.

Like Jefferson, he was a member of the Committee of Five appointed to draw up the Declaration. But Jefferson's well-earned reputation for a beautifully polished pen made it inevitable that he should be chosen to do the actual writing.

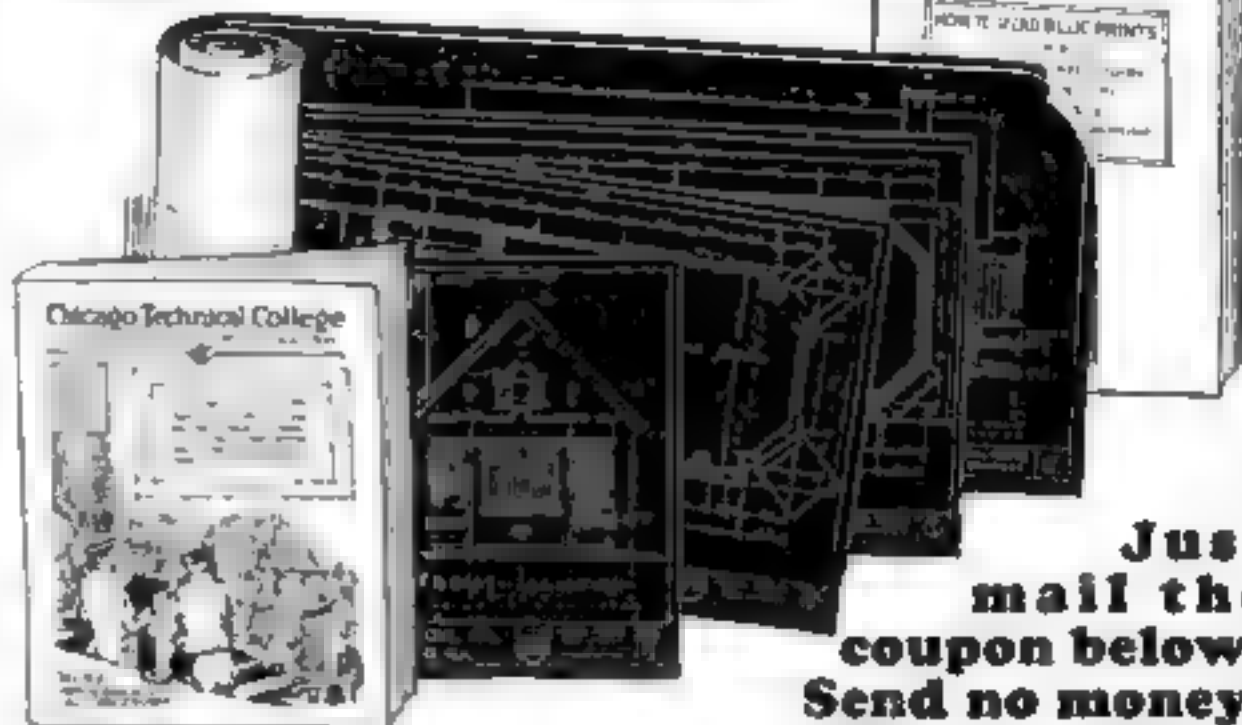
"WE HOLD these truths to be sacred and undeniable." That, as Jefferson wrote it, was the phrase; smoothly rounded enough. But to Franklin, the phrase was too long to be emphatic, and too general, because it was applicable to any truth, wherever found. Would any body of men, prepared to "hang together or hang separately," pledge "their lives, their fortunes, and their sacred honor" for any truths so vaguely introduced? Franklin thought not.

There is no written record that he reasoned in this way, but there is a very definite record—proved by the microscope of his conclusion. Let anyone read the original aloud, as Jefferson put it, and then do the same after Franklin had taken up his quill, crossed out the last three words, and left behind him, for all time "We hold these truths to be self-evident."

Living in the eighteenth century, Franklin used its dignified English. But he was fully awake to the value of what we, in the twentieth century, call "punch."

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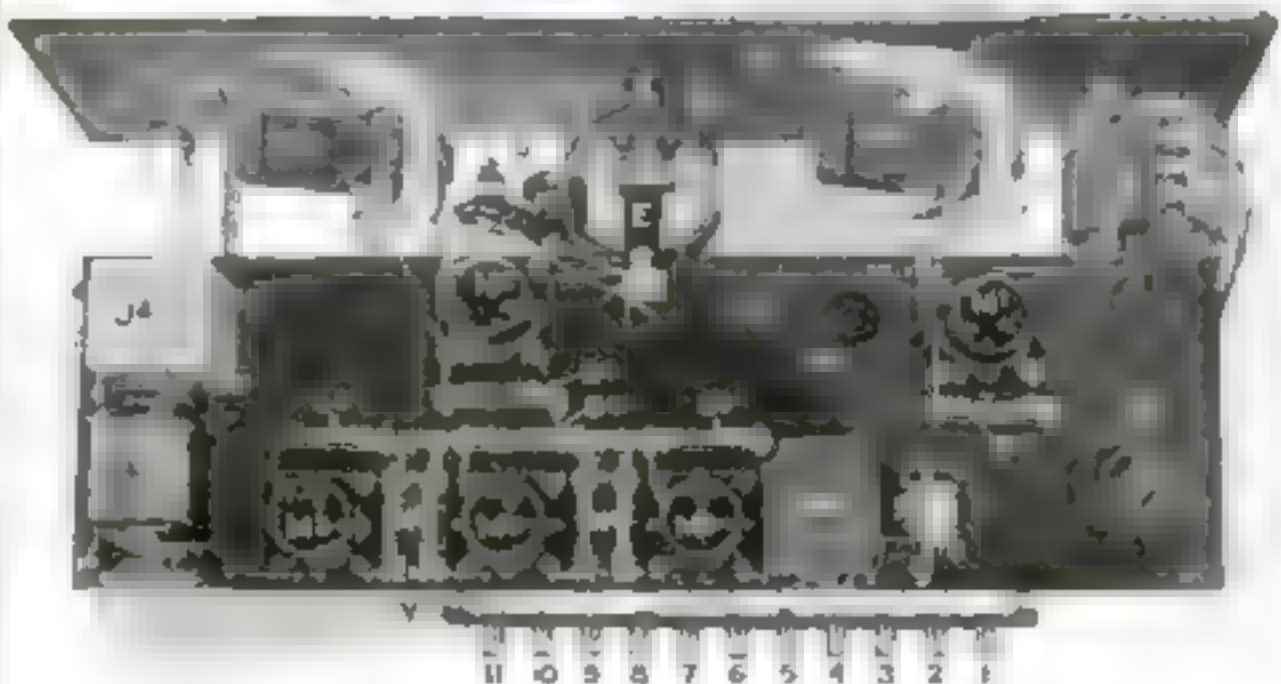
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A Powerful New Five-Tube Set



Be Careful to Place Tuning Units Exactly at Right Angles

Fig. 3. This illustration shows you how to arrange the parts. The tuning coils are well spaced from all other parts so that no losses are introduced into the radio-frequency circuits.

ently in this way, do not hesitate to write to POPULAR SCIENCE MONTHLY for information or advice. The list of radio apparatus approved by the Popular Science Institute of Standards will prove a help in selecting reliable parts.

Be sure to purchase a standard type of radio cabinet large enough for the 7 by 24 inch front panel and 10 inches deep before you do any work on the set, because the first construction job is to cut off the sub-panel to the proper length to fit into the cabinet and then fit it to the front panel by means of two brass right-angle brackets bent up from strip stock. The front edge of the sub-panel should be three inches from the front panel and the top surface of the sub-panel should be about 1 1/2 inches above the bottom edge of the front panel. Remember that the balancing condenser *H* projects below the panel, so be sure to mount the sub-panel high enough to provide clearance for this condenser. If you have the sub-panel too high, however, the top of the cabinet will strike the vacuum tubes. Take these factors into consideration when you are buying the balancing condenser *H* and the tube sockets.

NOW cut an opening in the back of the cabinet for the binding post panel after you have

fitted it to the sub-panel. After that you can nail in the wooden supporting strips at each end of the cabinet. A careful study of the illustrations will show you how this should be done. Full details are given in the blueprints.

The factory-made tuning unit *A, B* is mounted easily on the end of a 2-inch No. 6-32 brass screw as shown in Figs. 1 and 2. Be sure that coils *B* and *D* are set exactly at right angles, as illustrated.

MOUNT the sockets *M1* and *M2* with the *G* and *P* terminals toward the front panel and place sockets *M3, M4* and *M5* with the *G* and *P* terminals close to the rear edge of the sub-panel. This puts all of the filament terminals of the sockets near the center of the sub-panel and the self-adjusting rheostats wired to them.

The audio transformer *K* should be set with the *G* terminal next to the *G* terminal of socket *M3* and the resistance-coupling mountings *N1* and *N2* should be placed with the

(Continued on page 163)



Fig. 7. The knob at the left controls volume. The knob in the center regulates regeneration—it is not used except for distant stations.

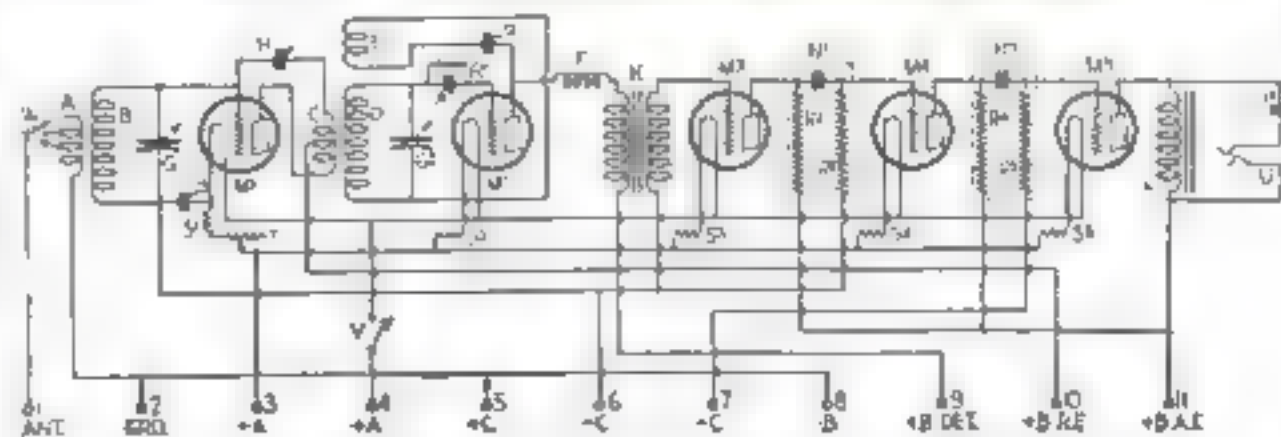


Fig. 8. The theoretical wiring diagram will be preferred by radio amateurs who know the meaning of radio symbols. All parts are lettered as in the picture diagram of Fig. 4.

A Powerful Five-Tube Set

(Continued from page 152)

P and G terminals toward the back of the set, where they will be as close as possible to the G and P terminals of sockets M3, M4 and M5 so that the connections will be short.

It is desirable also to mount by-pass condenser J4 with the terminals toward the end of the set away from the tuning units so that they will not be too close to the variable condenser C2.

You will find that No. 6-32 brass machine screws and nuts are fine for bolting the various parts to the subpanel and a No. 25 drill will make a hole with just enough clearance so that you will have no difficulty in assembling. A smaller drill can be used for the holes through which the connecting wires are passed. Study the illustrations and wiring diagrams carefully so that you will be sure to drill all of the holes needed for the wiring before you start assembling the instruments.

When everything is bolted in place, you will be ready to start the wiring.

THE filament wiring should be put in first. Run a wire from binding post No. 3 to one terminal of rheostat T and to self-adjusting rheostats S2, S3, S4 and S5. Then connect the remaining terminal of rheostat T with one terminal of self-adjusting rheostat S1. Now connect the remaining terminal of S1 to the nearest filament terminal of socket M1, connect S2 to M2, S3 to M3, S4 to M4 and S5 to M5. You will note from the illustration of Fig. 5 that the self-adjusting rheostats are placed so that one terminal of each is close to the socket terminal to which it connects.

Now connect all the remaining filament terminals of the five sockets together and to one terminal of filament switch F. Connect the other terminal of filament switch F directly to binding post No. 4. This completes the filament wiring that

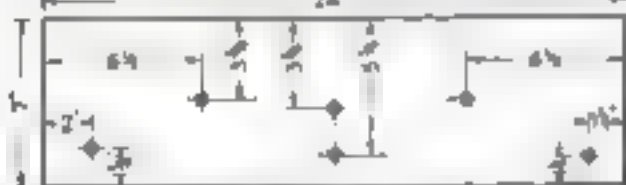


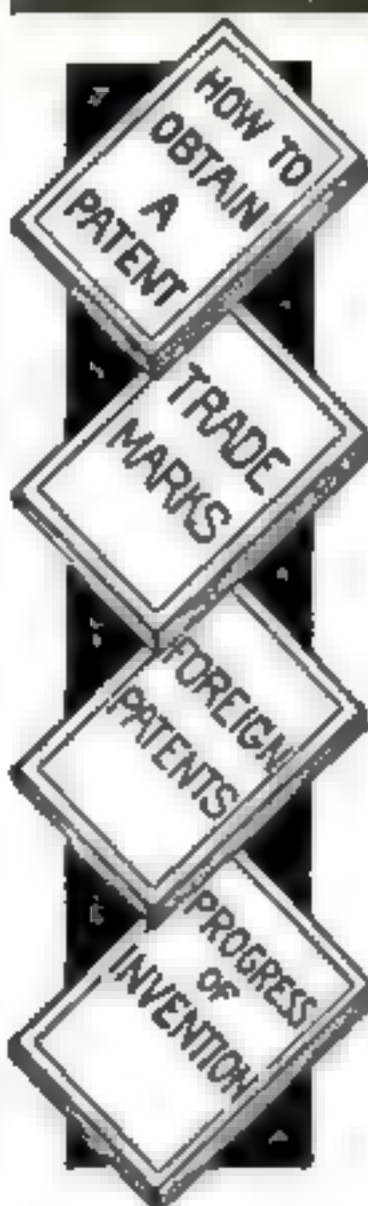
Fig. 6. Here is the panel layout for the new set illustrated in Fig. 7. Only centers are given

carries the current from the A-battery to light the tubes. The case of the audio by-pass condenser J4 should be grounded to the filament wiring at the nearest convenient point. The way to do this is to put a soldering lug under one of the nuts that bolts J4 to the subpanel and run a wire from this lug to the nearest point on the wire that is connected to binding post No. 3.

YOU will find that the simplest way to make connections from several instruments to the same wire is to solder the ends of the wire to the two terminals that are farthest apart and then run branches through the holes in the subpanel to the terminals in between.

Next connect binding posts Nos. 2, 3, 5 and 6 together and then run a wire from binding post No. 9 (Continued on page 154)

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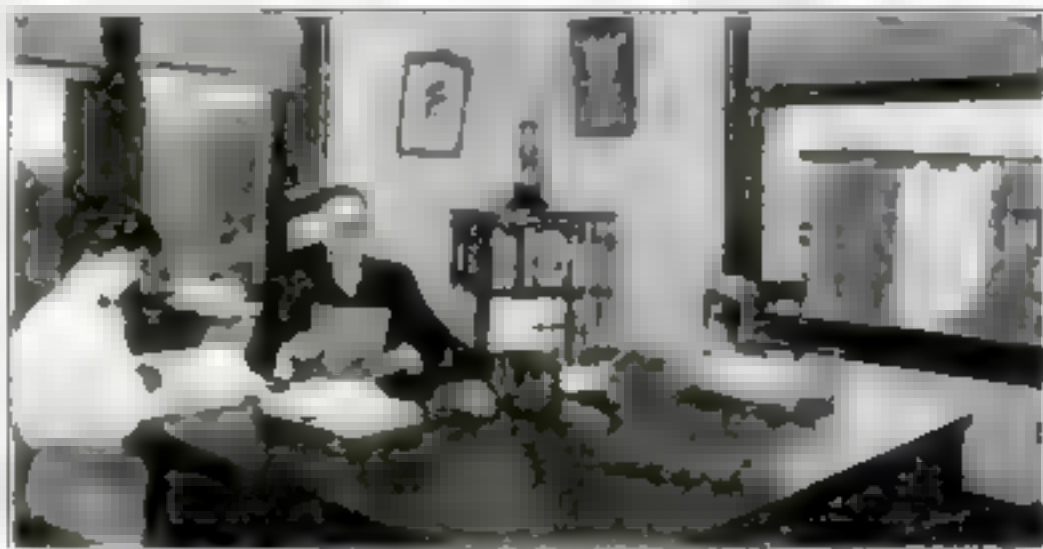
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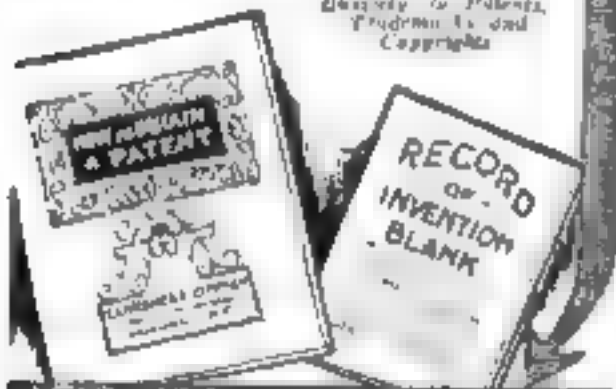
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• **Вопрос**

Appendix

*Important: Please do not use names (last)

A Powerful Five-Tube Set

(Cont'd from page 104)

to the B terminal of audio transformer K. Then run a wire from binding post No. 10 to the center tap of coil C (this is lug No. 2 on the commercial type tuning unit).

Now run a wire connecting up binding post No. 11 with the B terminals of resistance-coupling mountings M1 and M2, one terminal of audio blocking choke L and one terminal of jack E.

Next connect the *F* terminal of resistance-coupling mounting N2 with binding post No. 7.

RUN a wire from binding post No. 1 to the switch arm of switch *W*. Then connect one end of coil *A* and the two taps (these are lugs Nos. 2, 3 and 4 on the commercial type unit) to the contact lugs of switch *W*. Connect the remaining end of coil *A* (this is lug No. 1 on the commercial unit) to binding post No. 2 by way of the wire from rheostat *T* that goes directly to binding post No. 3, which you have already connected to binding post No. 2.

Now connect the end of coil *B* (this is lug No. 5 on the commercial type unit) that is farthest from the front panel with the *G* terminal of socket *M1*, and run a branch from this wire to the stationary plate connection of variable condenser *cd*. Then connect the other end of con. *B* (lug No. 6 on commercial unit) with the rotary plates of the condenser *cd* and continue this wire under the subpanel to binding post No. 6, with branches going to the *F* terminal of transformer *K* and the *F* terminal of resistance-coupling mounting *N*. Connect one terminal of by-pass condenser *dd* to this wire and the other terminal of *dd* to the nearest filament terminal of socket *M1*.

Connect the stationary plates of balancing condenser *H* with the *G* terminal of socket *M* 1, and run a wire from the rotary plates of condenser *H* to the lower end of coil *C* (this is lug No. 1 on the commercial tuning unit *C, D, E*). Then connect the other end of coil *C* (lug No. 2 on commercial unit) with the *P* terminal of socket *M* 1.

NEXT connect the lower end of coil *D* (lug No. 4 on the commercial unit) to one terminal of grid condenser *J1*, and connect the other terminal of condenser *J1* with the *G* terminal of socket *H2*. Connect the stationary plates of condenser *G3* to the coil end of condenser *J1*. Make these connections just as short as possible.

Now run a wire from the upper end of coil *D* (lug No. 5 on commercial unit) around socket *M*² and solder it to the rotary plate connection of condenser *C*. Drop a branch from this wire to the filament terminal of socket *M*¹ that is connected to switch *V* if you intend to use a 201A type tube as a detector. If you want to use the new 200A type detector tube, make this connection to the filament terminal of socket *M*² that is also connected to the self-adjusting rheostat *S*2 instead of to (Continued on page 127)

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To the Man With an Idea



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Advice for Popular Science readers regarding safe and profitable investments. See page 4.

A Powerful Five-Tube Set

(Continued from page 154)

the positive terminal. If at any time you decide to change tubes, be sure to remove one wire before you put in the other, as otherwise you will have a short circuit that will result in burning out the self-adjusting rheostat S2.

Connect one terminal of radio-frequency choke *P* to the *P* terminal of socket *M2*. Connect one terminal of bypass condenser *J2* to this same wire, and connect the other terminal of *J2* to one terminal of tickler coil *L* (lug No. 7 on the commercial unit). Connect the remaining terminal of coil *L* (lug No. 8 on the commercial unit) to the wire that goes from filament switch *V* to the filament terminals of the tube sockets.

NOW connect the remaining terminal of choke *P* to the *P* terminal of transformer *K*. Connect the *G* terminal of transformer *K* to the *G* terminal of socket *M3*. Connect the *P* terminal of socket *M3* with the *P* terminal of resistance-coupling mounting *N1*.

Then connect the *G* terminal of *N1* with the *G* terminal of socket *M4*, the *P* terminal of socket *M4* to the *P* terminal of *N2*, the *G* terminal of *N2* to the *G* terminal of socket *M5*, and connect the *P* terminal of socket *M5* to the remaining terminal of choke *L* and one terminal of condenser *J4*. Connect the remaining terminal of *J4* with the remaining terminal of jack *U*, and the wiring is complete.

After you have finished the wiring, be sure to check your work at least twice to be sure that there are no errors.

To put the set into operation, connect up the antenna and ground to binding posts Nos. 1 and 2. Connect a 6-volt storage battery to binding posts Nos. 3 and 4. Connect the minus end of the B-battery to binding post No. 8. Apply 45 volts to binding post No. 9. Connect up 60 volts to binding post No. 10, and 157½ volts to binding post No. 11 if you use the 112 type power tube in socket *M5* or 180 volts if you use the 171 type power tube in the last socket.

THE plus terminal of the C-battery should be connected to binding post No. 5. Use 4½ volts C-battery on binding post No. 6, and 9 volts on No. 7 with the 112 tube, or 40 volts if you use the 171 tube.

Using the 171 tube and the battery voltages given above, the set uses 5 mls of current. With the 112 tube it uses 8 mls, and if you use 201A tubes throughout, the current consumption is only 5 to 6 mls.

In the next issue, in the Home Workshop section, there will be a second article, covering the fine points of balancing this model five-tube set. The use of various combinations of tubes and other important details showing you how to get the best results will also be explained.

Remember that if there are any details of the construction or the wiring of the receiver that do not seem clear, the staff of POPULAR SCIENCE MONTHLY will be glad to answer questions.

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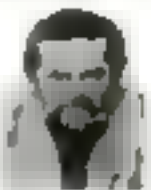
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Mistakes to Avoid in Placing a House

(Continued from page 137)

"Poured concrete is standard," was my answer. "It has to be done well to maintain its reputation. Footings and walls can be made in one operation, and if a power mixer cleans up the job in one day you have a seamless monolithic base for your home. A mix of one part cement, three parts sand and five of gravel or crushed stone will be right in most cases."

"What do you say to foundations made of concrete blocks?" asked Rob. "They're quite common, I notice."

"Yes, and they do very well. It's largely a question of local conditions whether to use blocks or poured stuff. Blocks are convenient to handle, require no form or mixing labor, and are easily laid up. They are not so good in a damp site because to make them water-tight you have to coat the outside with hot tar and maybe also plaster the inside with a rich cement mortar. But an inferior poured wall may require the same treatment."

"**SIZE** up the location in choosing your foundation material. A deep cellar will have more water trouble than a cellar not far down. If springs appear in the excavation, that's a hint to use first-class solid concrete."

"I guess the cellar floor needs to be made by a concrete chef, as well as the walls," said the young fellow.

"It deserves the faithful workmanship of my Italian friend Carmine. He can make you a bone-dry floor, smooth as polished stone, having gentle slopes, imperceptible to the eye, to lead any chance water away to the trap drains. His method is first to level the earth. Then he lays the tile drain lines, if these are required. He fills the whole area with six inches of hard cinders and tamps them down well. He then applies about three inches of rough concrete and gives it slope with line, straight edge and level. He finishes the top with an inch of rich cement mortar, on the damp surface of which he sprinkles a little dry cement before troweling."

"**WHILE** Carmine uses the spirit level, his eye is about as reliable an instrument. It is certainly more artistic. When an argument arises between his eye and his level, he gives the benefit of the doubt to the former, with beautiful results."

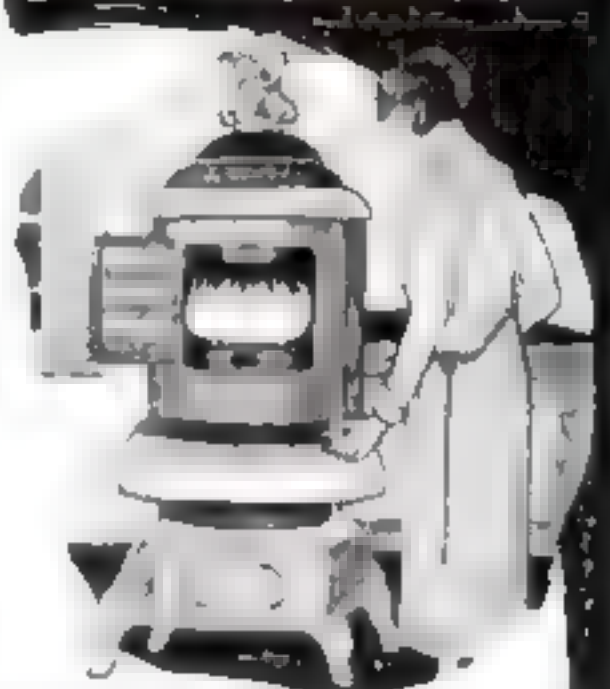
"If your Carmine is a real person, I want him to work on our house," exclaimed Ellen enthusiastically.

"I'll show you examples of his art on my place. He is only one of quite a number of good craftsmen in the building line. I guess everybody is beginning to appreciate the merit of artists, even though they wear overalls. In New York lately they awarded a medal to a hod carrier for deft and devoted performance."

"I'll bet he deserved it more than some birds do their honorary degrees from colleges," said Rob.

Next month—another article to help you with your house building problems.

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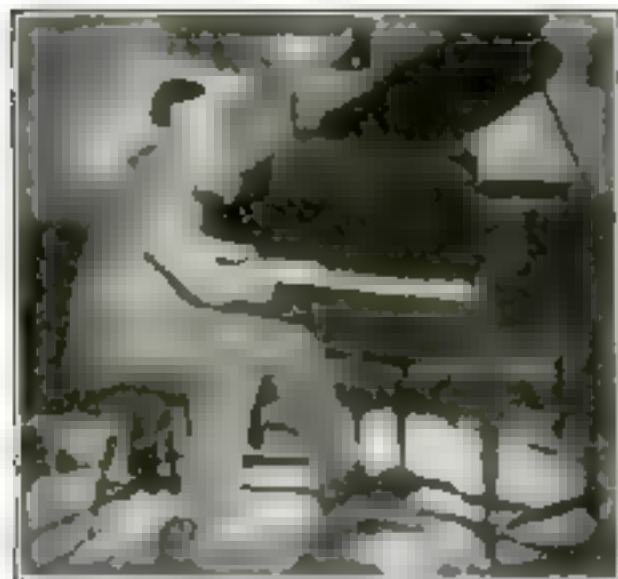
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By R. C. JAMES

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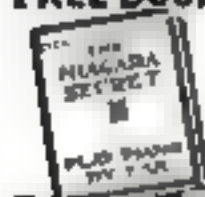
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Magic Things We Do with Glass

(Continued from page 159)



Another flower in the Harvard collection—*Rhipsalis Engelmanni*. From the sharp spines to the delicate petals, it is blown glass.

These pots are removed from the ovens by electric cranes, and their contents spilled over steel casting tables where the glass is rolled flat by twenty-five-ton steel rollers. Finally the rough plates are cooled, ground and polished to half their original thickness.

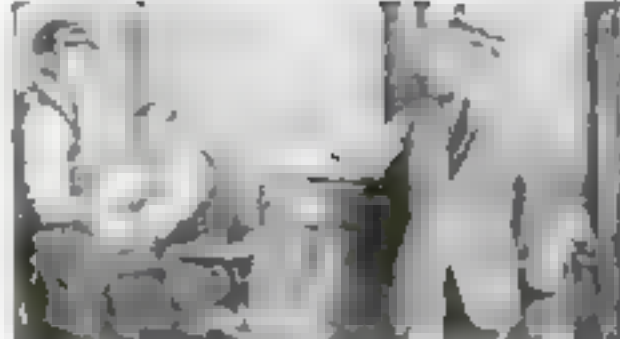
It is possible that the historic method of making glass from sand eventually may give place to new and radically different processes. Just a few weeks ago, for instance, chemists at Cornell University announced the discovery of a way to make sandless glass by using a compound of the metal called germanium for the present, however, the whirling grains of sand still remain the commonest material for glass manufacture.

Perhaps the most fascinating of the art, to me, had to do with the coloring of glass. In many cases, glassmakers told me, desired tints had been obtained only by pure accident. For example, the red glass in the tail light of your car came from the discovery by a French scientist that ruby glass of remarkable transparency and radiation could be colored by selenium, then a waste product.

ANOTHER chemist, by throwing a little salt into a glass melting pot, a score of years ago, hit upon the discovery of a glass for lampshades that would produce a white light without glare. The same chemist was instrumental in producing almost perfect reproduction of natural daylight for the stage by the combination of red, green, and blue spotlights.

If you are particular about the exact color of your necktie, you probably carry your choice to the store door to see it by daylight—or else use the "daylight lamp," which glass has made possible. The bulb is made of light navy blue glass which absorbs those rays which give ordinary artificial light a yellowish tinge.

Usually the coloring in glass is produced by mixing rust of various metals with the clear glass. Thus chromium produces chrome green or yellow; manganese, violet; cobalt, purple-blue; ferrous oxide, olive green or pale blue; lead, pale yellow; tellurium, pale pink; nickel, violet or brown; copper, peacock blue or green.



"Good Bye, Boys!"

"To-day I dropped in for a last word with the boys at the office. And as I saw Tom and Dave there at the same old desk it came to me suddenly that they had been there just so the day I came with the firm four years ago.

"When I started here I was put at a desk and given certain routine things to do. But after a few months I began to realize that I was nothing but a human machine and that I couldn't expect to advance that way.

So I wrote to Scranton and arranged for a spare-time study course that would give me special training for my work. Why, do you know, it gave me a whole new interest in my business. In a few months I was given more responsibility and more money. Since then I've had three increases, six months ago I was put in charge of my department, and now my big chance has come. I'm to be manager of our Western branch at \$5000 a year! It just shows what spare-time training will do."

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When All Things Are Possible

(Continued from page 43)

director of the New York Zoological Society, to get specimens of deep-sea life. In his book, *The Arcturus Adventure*, Mr. Beebe describes his experiences.

Among the amazing devices on this remarkable ship there were a "bow pulpit" and a "boom walk" or sort of permanent gangplank extending from the port side, and there were all sorts of nets to snare the strange dwellers in the waters beneath, and dredges to scour the ocean bottom.

BEEBE describes the "pulpit" as follows:

"On every sea trip I have ever taken, my favorite position is as far out on the bow as possible, looking enviously down at the floating creatures which are constantly passing. And now I had devised this pulpit which answered every requirement. It is a bit of iron grating surrounded by a waist-high iron rail and fastened astride the bow of the *Arcturus*. It can be raised or lowered to any position."

The "boom walk," a startling innovation, was suggested to him, Beebe said, by seeing a drawing of a pirate's captive walking the plank. It was made by rigging outboard on the port side two thirty-foot booms, one slightly above the other, and about three feet apart. To these a duckboard walk was laced. When this contrivance was swung at right angles to the vessel's side, it formed a runway extending beyond the wave thrown up by the *Arcturus*.

Trawling with surface nets from the end the scientists trawled for and harpooned dolphin fish and sharks. At dusk two clusters of electric lights were focused on a twenty-foot circle of water which drew a fascinating concentration of ocean life. In his book Beebe describes the nets:

"FIRST there was paid out the otter trawl, a great bag of netting forty feet in length, with its gaping mouth held wide open by the oblique pull of two iron-bound boards. Then, at intervals of fifty fathoms, meter nets were lowered, each twenty feet long, made of the finest, most costly silk, with a mouth composed of a brass ring a yard in diameter. Five of these nets were attached to the steel cable by guide ropes, and they trailed straight out behind at various depths as the ship steamed at slowest speed through the water. For three hours they were pulled gently along at 800, 450, 400, 350 and 300 fathoms depth, blindly, uncontrollably but usually successfully engulfing the weird beings which happened to float along in their path."

By all these means the *Arcturus* adventurers brought up deep-water fish of all manner of strangeness, misshapen, translucent, some with great heads and no bodies, some with strange protruding spines, some even equipped with lights in rows along their sides or at the ends of tentacles! One dolphin had to be pinned to the deck after a wrestling match with the adventurous fishermen.



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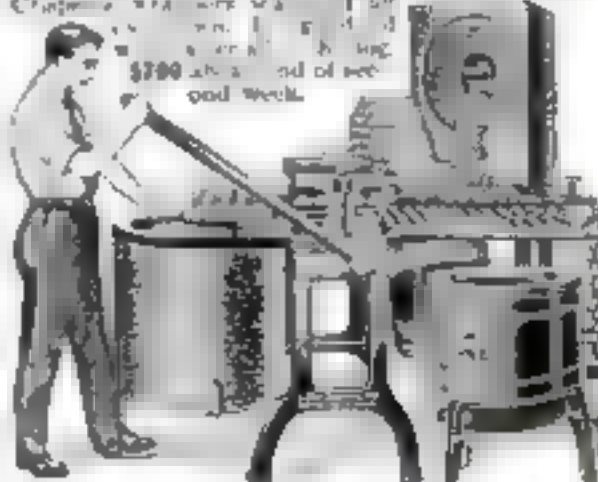
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Answers to the Sam Loyd Tests on page 43

Mental Sharpshooting

The numbers on the target all being divisible by 6, the total score must be a multiple of 6 as well as of 17. Six shots—30, 30, 12, 12, 12, 6—total 102, is the smallest possible score to average 17 points to the shot.

Cutting the Doughnut

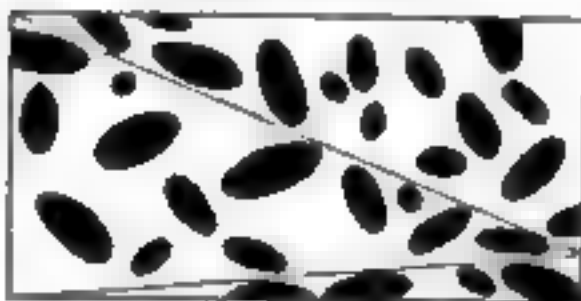


The diagram shows how the doughnut is made to produce seven pieces from one straight cut. True, the seventh piece is no more than that little bump which protrudes across the line. It's a piece, nevertheless, and must be included in the count.

The Cats and Kittens

To make the two weighings alike, we have but to substitute a cat for a kitten on the lower scales. This change calls for an additional four pounds on the weight side. Thus we learn that a cat's weight exceeds a kitten's by four pounds. Substitute three cats for three kittens on the upper scales, at the same time adding twelve pounds to the other side to preserve the balance, and we have seven cats balancing against forty-nine pounds. Thus it is proved that a cat weighs seven pounds and a kitten three.

Through the Reefs



The diagram illustrates the two-stroke route across the reef zone.

Building a Sentence

By interlarding the line with the letter M it is made to read: MAD MEN MIMIC AND MOCK

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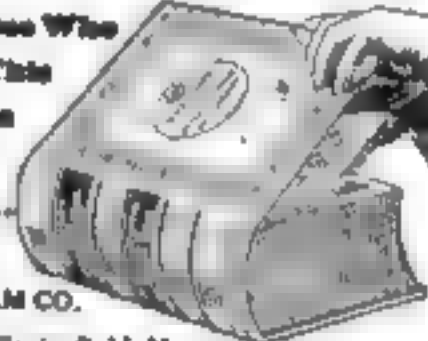
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Here Are Correct Answers to Questions on Page 52

1. When an athlete starts to exert himself, the sudden demand for more oxygen to take care of the increased work performed by the muscles causes a speeding up of the heart action. "Second wind" begins when the increased action of the heart and lungs reaches the point where the supply of oxygen just equals the consumption.

2. Nearly every muscle in the body receives a slight impulse during a sneeze—over fifty muscles in all.

3. The tiny nerves of sight that make up the retina of the eye are far more numerous than the grains of silver that make up the image in the ordinary photographic film. The lens of the camera transmits the fine detail to the plate in the same way that the lens of the eye transmits the detail to the retina. The difference in results lies in the recording device and not in the lens.

4. Some kinds of wood are more dense than others, being so heavy that they weigh more than the water displaced and consequently they sink.

5. It is possible to see a rifle bullet while it is actually traveling through the air by using a telescope placed parallel with and close to the barrel of the rifle. While the bullet travels thousands of feet a second in a direction away from the muzzle, its falling motion is no faster than any other falling body, and against a white background the bullet can be seen for a small fraction of a second.

6. Music is made up of vibrations of frequencies ranging from about 20 a second up to 30,000 a second. Only the best grades of radio loudspeakers are capable of approximating uniform reproduction of this wide range of frequencies.

7. While nickel itself turns into nickel oxide only at an extremely slow rate, the coating of nickel is rarely absolutely perfect. Wherever there is the slightest flaw, the iron surface underneath the nickel coating rusts and makes it peel off.

8. Water boils at 212° at sea level. On the top of a high mountain, the atmospheric pressure is lower and water boils at a lower temperature so that it takes longer to cook the egg.

9. The flame of a gas stove is blue because sufficient air is mixed with the gas to give complete combustion. An ordinary gas jet produces a bright yellow flame because the fine particles of carbon are heated to incandescence before sufficient oxygen from the air reaches them to cause complete combustion.

10. When an automobile goes around a corner, the outside rear wheel rotates faster than the inside one. The differential gear permits power to be applied to both rear wheels even when one is turning faster than the other.

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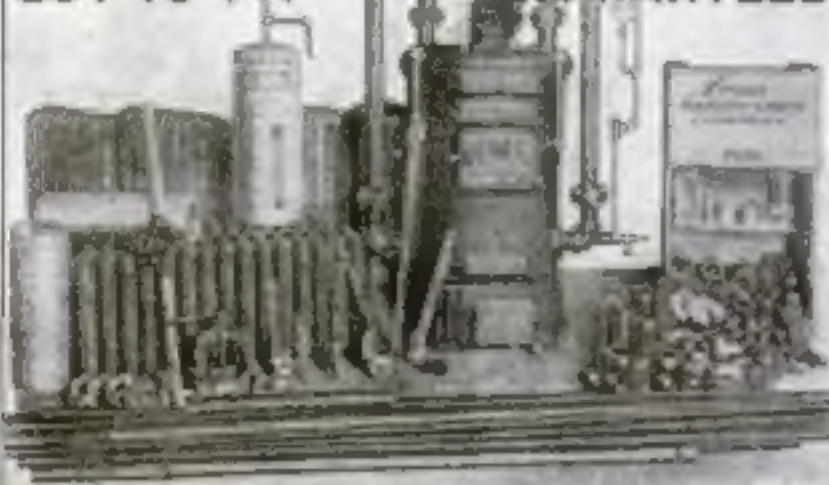
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